RAD
data communications

Installation and Operation Manual

FCD-E1

E1 or Fractional E1 Access Unit

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Installation and Operation Manual

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General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

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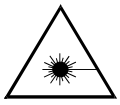
Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- **Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.**
- **Do not attempt to adjust the laser drive current.**
- **Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.**
- **The use of optical devices with the equipment will increase eye hazard.**
- **Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.**

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connection of AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connection of DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC mains are floating, the switch must disconnect both poles simultaneously.

Connection of Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention

Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkströrungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Declaration of Conformity

Manufacturer's Name:	RAD Data Communications Ltd.
Manufacturer's Address:	24 Raoul Wallenberg St. Tel Aviv 69719 Israel

declares that the product:

Product Name:	FCD-E1

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics– Limits and methods of measurement.
Safety:	EN 60950 (1992/93)	Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 73/23/EEC and the R&TTE Directive 99/5/EC for wired equipment. The product was tested in a typical configuration.

Tel Aviv, March 17, 2005

Haim Karshen
VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

If you are familiar with the FCD-E1, use this guide to prepare it for operation, starting from its factory-default configuration.

Preliminary Preparations

At this stage, do not connect any cables to the FCD-E1.

Caution Before performing the preliminary preparation procedures described below, review the safety precautions given in *Section 2.1.*

Connection to Power and Grounding

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

AC power is supplied to the FCD-E1 through the 5-foot (1.5m) standard power cable terminated in a standard 3-prong plug.

The connection of the FCD-E1 to a DC power source is permanent and is made by means of a terminal block adapter that is inserted in the DC inlet.

The AC power cord plug must be inserted in an outlet provided with a protective ground (earth) contact, whereas when using DC power it is necessary to ground the AD grounding terminal. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Jumper and Switch Settings

The following settings are shipped from the factory:

Component	Setting	Default Value
Main Board	Ground	Signal Ground connected to Frame Ground
	Main Link Interface	Balanced Interface
	Alarm Relay	DCD, CTS
	Front Panel Buttons	Enabled
	Clock Polarity	Normal
Sublink Board	Sublink Interface	Balanced Interface

If you need to change any of the default values, see *Chapter 2 - Setting Jumpers and Switches.*

Cable Connections

Refer to the site installation plan, and connect the prescribed cables to the FCD-E1 ports:

Cable	Connect to …
Main link cable	E1/T1 MAIN connector
Sublink cable (optional)	E1/T1 SUB connector
Data channel 1 cable	CH1 connector
Data channel 2 cable (optional)	CH2 connector
Ethernet cable	10/100BASE-T connector

Note *When using adapter cables for the data channels, first connect the adapter cable to the data channel connector, and then connect the user's data cable to the adapter connector.*

When ready, apply power to the FCD-E1.

Configuration Using a Supervisory Terminal

Starting a Preliminary Configuration Session

1. Connect a terminal to the CONTROL DCE port on the FCD-E1 rear panel (use a straight cable).

   You may use any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface. ***Make sure to use VT-100 terminal emulation.***

2. Configure the terminal for **19.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

3. Connect the FCD-E1 to power.

4. Press the **<Enter>** key several times in sequence: you should see the FCD-E1 prompt, **FCD>**.

   If you see **PASSWORD>** and the FCD-E1 default password has not yet been changed, type **RAD** and then press **<Enter>** to obtain the prompt. If your password is accepted, you will see the FCD-E1 prompt.

Note *If you cannot establish communication with the FCD-E1, reset FCD-E1 CONTROL port parameters to the factory defaults using the internal switch SW2 using the procedure described in Chapter 2.*

Configuration Procedure

Perform the following actions in the order given below.

Step	Action	Use the Command
1	Reset the database to the default parameters	**INIT DB**
2	Define the terminal control codes	**DEF TERM**
3	Configure the supervisory port	**DEF SP** **DEF CALL**
4	Set FCD-E1 system time and date	**TIME** **DATE**
5	Configure system parameters	**DEF SYS**
6	Configure the main link parameters	**DEF ML**
7	Configure the sub link parameters (optional)	**DEF SL**
8	Configure the data channel parameters	**DEF CH 1** **DEF CH 2** (when installed)
9	Define the general system parameters	**DEF NAME** **DEF NODE** **DEF PWD** **DEF AGENT** **DEF MANAGER LIST**
10	Define the alarm handling parameters	**DEF AR** **DEF ALM MASK**

FCD-E1 is now ready for operation.

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Chapter 1
Introduction

1.1 Overview

FCD-E1 is an access unit for E1 (2.048 Mbps) and fractional E1 services that supports advanced management capabilities, including SNMP.

FCD-E1 is a standalone compact unit, intended for installation on desktops or shelves. Unit height is 1U (1.75-inch). Optional rack-mount adapter kits enable the installation of one or two FCD-E1 units in a 19-inch rack.

The wide range of user ports supported by FCD-E1 enables it to serve as an access unit and integrating multiplexer for E1 and fractional E1 services.

FCD-E1 can also be operated in an unframed mode. In this mode, FCD-E1 accepts a 2048 kbps data stream through a synchronous data port and converts it to an ITU-T Rec. G.703 unframed signal for transport over the E1 main link. Thus, FCD-E1 can also serve as an interface converter and high-speed, short-distance modem.

Product Options

FCD-E1 is available in several versions that differ in the number and type of user ports:

- One or two synchronous data channels. The data channels can be ordered with V.35, V.36/RS-449, or X.21 interfaces.
- One synchronous data channel (with V.35, V.36/RS-449, or X.21 interface) and one Ethernet 10BaseT interface with internal remote bridge (bridge function can be enabled or disabled by the user). The bridge can be ordered with (IR-ETH/Q) or without (IR-ETH) VLAN support. In this version the Ethernet port is always the upper one (Channel 2), and the synchronous data channel is the lower one (Channel 1).
- One E1 sublink, which provides a drop-and-insert capability, and enables the connection of fractional E1 equipment and digital PBXs to the E1 main link.

Note *In this manual, the generic term FCD-E1 is used when the information is applicable to all FCD-E1 versions. Information applicable to a specific version is explicitly identified.*

Application

Figure 1-1 shows a typical application for FCD-E1, which illustrates the utilization of its capabilities. In this application, FCD-E1 provides an extended Ethernet management over an E1 network.

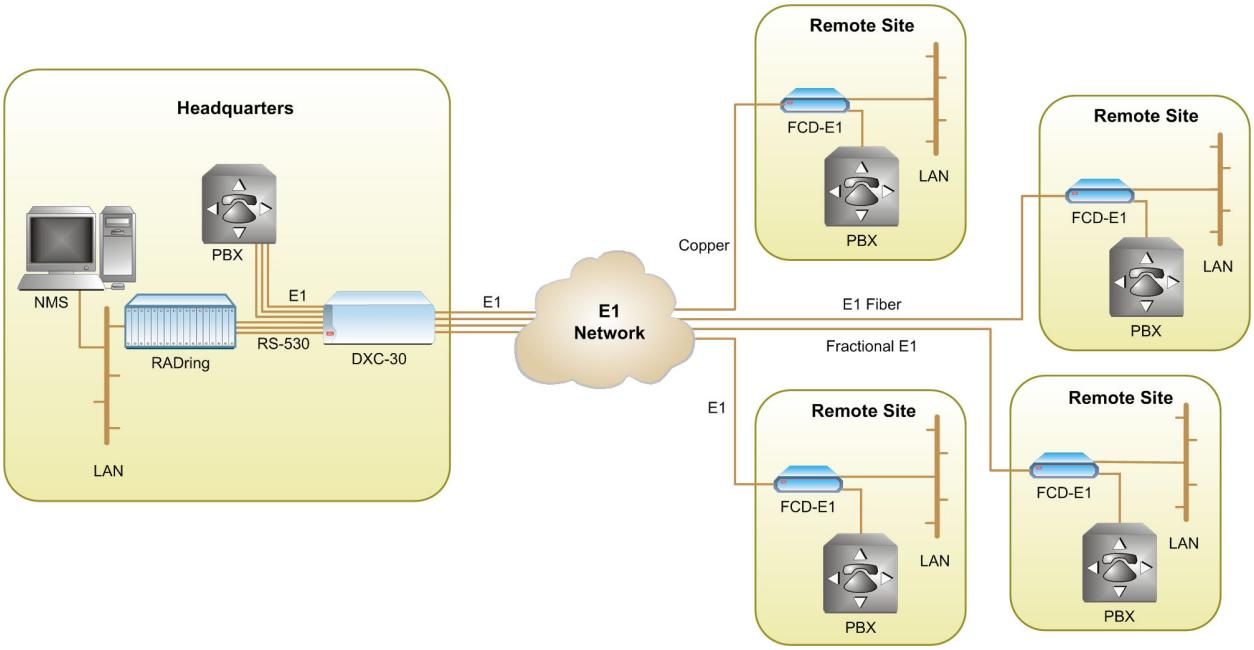


Figure 1-1. Typical FCD-E1 Application

Features

Main Link Interfaces

The interface supports the standard E1 framing formats, i.e., comply with the requirements of ITU-T Rec. G.704 and G.732, and support both G732N framing (2 per multiframe) and G732S framing (16 frames per multiframe, also called timeslot 16 multiframes), in accordance with user's selection.

FCD-E1 can also be operated in an unframed mode. In this mode, FCD-E1 accepts an 2048 kbps data stream through a synchronous data port and converts it to an ITU-T Rec. G.703 unframed signal for transport over the E1 main link.

FCD-E1 can be ordered with electrical or optical main link interfaces.

Electrical Main Link

The FCD-E1 main link meets the requirements of ITU-T Rec. G.703, G.704, G.706, G.732, and G.823, and supports G732N and G732S multiframes (2 or 16 frames per multiframe, respectively), in accordance with user's selection. The link also supports the CRC-4 function in accordance with ITU-T Rec. G.704. The main link can also operate in the unframed mode, to generate an ITU-T Rec. G.703 unframed signal.

The framing mode, as well as the use of the CRC-4 function, is user-selectable.

For FCD-E1 versions with sublink, the framing mode and the CRC-4 function can be separately selected for the main link and sublink; therefore, FCD-E1 can also serve as a framing converter between the user's equipment connected to the sublink and the network. For example, FCD-E1 enables the connection of equipment that does not support the CRC-4 function to networks which use this function.

The main link has two line interfaces:

- 120Ω balanced line interface, terminated in an eight-pin RJ-45 (ISO 10173) connector.
- 75Ω unbalanced interface terminated in two BNC coaxial connectors.

The operating mode of the main link interface, DSU or LTU, is user-selectable. In the DSU mode, the maximum line attenuation is up to 10 dB; in the LTU mode, the maximum line attenuation is up to 36 dB, which for typical cables translates to a range of up to 2 km. This allows FCD-E1 to be placed at a distance of up to 2 km from the transmission equipment.

Optical Main Link

A wide range of fiber optic interfaces complying with ITU-T Rec. G.921 and G.956 is available for FCD-E1, to optimally meet a wide range of system requirements.

FCD-E1 can be ordered with fiber optic interface with laser transmitter for operation over 62.5/125 micron multimode fibers (typical attenuation –3.5 dB/km), as well as over low-loss 9/125-micron single-mode fibers (typical attenuation of 0.4 dB/km at 1310 nm, and 0.25 dB/km at 1550 nm). Each option can be ordered with ST or FC/PC connectors.

Table 1-1 provides information on the characteristics of the optical subsystem, including the maximum range over typical fiber optic cable.

Table 1-1. Fiber Optic Interface Characteristics

Wavelength [nm]	**Fiber Type** [μm]	**Power Coupled into Fiber** [dBm]	**Receiver Sensitivity** [dBm]	**Optical Budget** [dB]	**Maximum Receiver Input Power** [dBm]	**Receiver Dynamic Range** [dB]	**Typical Maximum Range** [km]	[mi]
850	62.5/125 multimode	–18	–38	20	–10	28	5	3
1310	9/125 single-mode	–12	–34	22	–12	28	55	34
1550	9/125 single-mode	–12	–34	22	–12	28	88	55

All the fiber optic interface options offer high performance and have a wide dynamic range, which ensures that the receiver will not saturate even when using short fiber optic cables. Saturation is caused when the optical power applied to the receiver exceeds its maximum allowed input power, and results in very high bit error rates.

The optical interface fully emulates the operation of a standard E1 electrical main link module, including the use of an HDB3-encoded optical signal, and AIS transmission.

Sublink Interface

FCD-E1 can be ordered with a sublink interface. The sublink interface is always an electrical interface. Its characteristics are identical to the characteristics of the electrical main link interface, except that it does not support the unframed mode.

Data Channel Interfaces

The FCD-E1 synchronous data channel can be ordered with one of the following types of interfaces: RS-530, V.35, X.21, and V.36/RS-449. Each data port is terminated in a 25-pin D-type female connector.

The conversion between the 25-pin channel interface connector and the standard V.35, X.21 or V.36 interface connectors is made by means of adapter cables:

- V.36/RS-449 interface: the adapter cable is terminated in a 37-pin D-type female connector.
- V.35 interface: the adapter cable is terminated in a 34-pin female connector.
- X.21 interface: the adapter cable is terminated in a 15-pin D-type female connector.

Suitable adapter cables can be ordered from RAD (see ***Error! Bookmark not defined.*** and *Chapter 2*).

The FCD-E1 synchronous data port supports the following control lines:

- **RTS** - input from the locally connected user's equipment.
- **CTS** - the user can permanently set the CTS line in the active state, or can make the CTS line follow the RTS line.
- **DSR** - the DSR line is always active when the FCD-E1 is powered, except when a remote main link test loopback is activated.
- **DCD** - the DCD line is active when the FCD-E1 main link interface is synchronized.

Ethernet Interfaces

The 10BaseT Ethernet interface complies with IEEE 802.3 and Ethernet V.2 standards. It is terminated in an RJ-45 shielded connector that operates over UTP media.

To provide control over the Ethernet traffic flowing through the main link, the Ethernet interface can be ordered with one of the following options:

- Full-feature remote bridge, IR-ETH. You can disable the bridge, to operate the FCD-E1 link as a LAN extender (repeater).
- Full-feature remote bridge with VLAN support, IR-ETH/Q. You can disable the bridge, to operate the FCD-E1 link as a LAN extender (repeater).

Both bridges can operate at wire speed. For further information on the IR-ETH and IR-ETH/Q interfaces, refer to *Appendix E* and *Appendix F,* respectively.

Timeslot Handling

When operating in any of the framed modes, FCD-E1 allows the user to configure the routing of the individual timeslots for each channel, and for the sublink. The routing can be modified during system operation, without disrupting the service to users of timeslots that are not rerouted. FCD-E1 automatically connects the timeslots in both the receive and transmit directions. The routing capabilities depend on the port type:

- For the sublink, you can select the timeslots to be transferred between the sublink and main links. A sublink timeslot is always routed to the main link timeslot with the same number.

  You can specify, for each sublink timeslot, the payload type (voice or data) carried in the timeslot. This enables correct handling of timeslots and of the associated signaling information during alarm conditions. An additional difference between voice and data timeslots is that voice timeslots can be connected only to a link, which uses G732S multiframes.

  To expedite the routing, FCD-E1 supports a "bundle" routing mode, called "sequential bundle" routing mode. One "bundle" (group of consecutive timeslots, identified by the number of the starting timeslot and the total number of timeslots) can be routed to the corresponding main link timeslots, where they are inserted in the main link frame sequentially, in consecutive timeslots.
- For data channels, the user can either individually select the main link timeslots in which the user's data is to be inserted, or can use the "bundle" routing mode. Timeslots connected to data channels are always defined as data timeslots.

To help you route correctly timeslots, FCD-E1 automatically checks the validity of the user's inputs, and reports, by means of error messages, inconsistencies and invalid selections. The conditions reported include:

- Attempt to allocate to user's traffic timeslots that must be reserved for system use: timeslot 16 when G732S multiframes are used, or a timeslot dedicated to the management traffic between two FCD-E1 connected in a link.
- Total bandwidth requested exceeds the available main link bandwidth:
  - Maximum 31 timeslots
  - Maximum 30 timeslots when using G732S multiframes or G732N multiframes with a timeslot dedicated to management
  - Maximum 29 timeslots when using G732S multiframes and a timeslot dedicated to management.

  The bandwidth carried by the available timeslots depends on the basic data rate selected by the user (56 or 64 kbps).
- Number of timeslots assigned to a data channel does not match the number required to support the specified channel data rate.
- Two or more timeslots are mapped to any given main link timeslot.
- Timeslots specified as voice timeslots are routed to a link, which uses G732N multiframes.

Timing

Multiple clock source selection provides maximum system timing flexibility, and supports hierarchical dissemination of timing information.

System Timing

Internally, FCD-E1 uses one system timing source (clock). This system clock determines the transmit timing of all the E1 links and data ports, and the timing of most other signal processing operations.

To achieve maximum flexibility in system integration and enable hierarchical distribution of timing in the system, FCD-E1 enables the user to select the source to which the master clock is locked. The available options are as follows:

- System clock source locked to the recovered receive clock of the main link, or sublink (when available).
- System clock source locked to an external clock (e.g., the transmit clock applied to a user-selected data port). The timing mode of the selected port must be DTE2.

Note

The DTE2 mode is not available on channels with X.21 interfaces, or on the Ethernet interface.

- System clock source locked to the internal crystal oscillator, which has an accuracy of ±50 ppm.

In addition to the selection of a main clock source, you can specify a fallback source, which is automatically selected in case the main source fails. The fail criteria are loss of the receive signal on the port selected as the main source, or inactive RTS line on the selected data port. The internal oscillator always serves as a fallback source, which is automatically selected in case the other selected timing sources fail.

Main Link Timing

FCD-E1 recovers the main link receive clock signal, and uses it as the timing source for the receive path. The main link transmit timing source, which is derived from the main system clock, can be locked to one of the following sources:

- Recovered receive clock
- External clock signal (derived from one of the synchronous data channels or from the sublink)
- Internal oscillator.

Sublink Timing

The sublink transmit clock is always locked to the main link transmit clock, and the receive clock is recovered from the incoming sublink signal.

The receive clock can be selected as an external clock source for the main link transmit clock.

Synchronous Data Port Timing

The FCD-E1 data port has three timing modes:

- **DCE** – the FCD-E1 data port provides transmit and receive clock, derived from the main system clock, for the user's equipment connected to the data port.
- **DTE1** – the FCD-E1 data port sends the receive data accompanied by the receive clock, derived from the main system clock, to the user's equipment connected to the data port, and accepts user's data according to the user's equipment transmit clock.
- **DTE2** – FCD-E1 transmits and receives data according to the clock signals provided by the equipment connected to the data port. When using this clocking mode, the main link rate must be locked to the clock signal supplied by the user's data port interface. The DTE2 mode is not available on channels with X.21 and Ethernet interfaces.

  FCD-E1 provides a FIFO buffer for the data channel, to absorb timing differences.

  FIFO size is generally automatically selected, however in the DTE2 timing mode, the user can select FIFO size to meet specific system requirements.

Ethernet Port Timing

The timing of the Ethernet processing circuits is always derived from the main system clock ("DCE" timing). This port cannot be selected as a timing source.

Management

FCD-E1 is designed for unattended operation. The FCD-E1 configuration, that is, the complete collection of its operating parameters, is determined by a database stored in non-volatile memory.

The FCD-E1 database management, as well as the other configuration, test, and monitoring activities (equipment status reading, alarm status and history, activation of test loops, reading of performance statistics, etc.) can be performed in three ways:

- **Supervision Terminal –** A "dumb" ASCII terminal connected to an RS-232 port of the FCD-E1 (or a PC running a terminal emulation program), controlled by the program stored in the FCD-E1, can be used as a supervision terminal. The terminal can also be connected through a modem link, to enable dial-in from a remote location. The FCD-E1 supports both point-to-point and multidrop connections.
- **SNMP Management –** The SNMP management capability enables fully graphical, user-friendly management using the RADview network management stations offered by RAD, as well as management by other SNMP-based management systems.
- **Telnet –** Remote management is also possible using the Telnet communication protocol, which uses TCP/IP communication, without the SNMP service. Telnet support enables a remote IP host to control the operation of the FCD-E1 using functions identical to those provided by a supervision terminal.

The communication between the management system and FCD-E1 can take place out-of-band (by connecting to the serial or Ethernet management ports) or inband (through the main and/or sublink). FCD-E1 includes a proprietary IP router for management traffic. This function enables FCD-E1 to transfer management traffic generated by, or addressed to, other FCD-E1 units, and also inband management

traffic addressed to other RAD equipment that operates over E1 links, such as the Megaplex modular TDM E1/T1 multiplexers, DXC multiservice access nodes, etc.

Alarms

FCD-E1 stores alarms detected during its operation in a buffer that can hold up to 100 alarms. During regular operation, an alarm indicator on the front panel lights when alarms are present in the alarm buffer, to notify the local operator that alarm conditions have been detected. The local operator can then review the contents of the alarm buffer using the supervision terminal, a Telnet host, or a management station.

In addition to the alarm buffer, the front-panel LED indicators display in real time the status of the main link and sublink, and alert when test loops are present in the system. Also, the FCD-E1 version with two RS-232 interfaces can automatically report alarms to a remote terminal using a dial-up modem.

FCD-E1 can provide an alarm indication by means of an alarm relay (dry contacts), which enables remote signaling of alarm conditions when FCD-E1 is located far from the personnel in charge for its proper operation.

The alarm relay has a pair of change-over dry contacts: the normally-open (NO) contacts close in case of alarm, and the normally-closed (NC) contacts open in case of alarm. The alarm contacts are floating with respect to the signal and chassis grounds of the FCD-E1.

Statistics Collection

When CRC-4 is used, FCD-E1 collects and stores E1 port statistics in compliance with ITU-T Rec. G.706. These statistics can be retrieved by the management functions, e.g., through the supervisory port, and via inband management.

Diagnostics

FCD-E1 has comprehensive diagnostics capabilities that include user-activated local and remote loopbacks on the data ports, on the sublink and main link.

Transmitting an inband code can activate the remote data port loopbacks. To enable testing of marginal links, FCD-E1 also offers bit error rate (BER) testing on the synchronous data channels, using a locally generated pseudorandom sequence. To provide compatibility with other BER testing equipment, the user can select the pseudorandom pattern.

Maintenance is further enhanced by an automatically performed power-up self-test, which provides circuit-level diagnostics data.

1.2 Physical Description

A 3D view of FCD-E1 is shown in *Figure 1-2*.

The front panel includes push buttons, LEDs, an LCD display and the supervision terminal connector for controlling and monitoring the FCD-E1 operation. For details, see *Chapter 3*.

The rear panel of the unit includes the power switch and all the user connectors. For details see *Chapter 2*. The rear panel of the Ethernet bridge includes, in addition, status indicators and switches for controlling the operation of the Ethernet interface. The LED indications for the IR-ETH and IR-ETH/Q interfaces are described in the *Appendix E* and *Appendix F*, respectively.

FCD-E1 is a compact standalone unit, intended for installation on desktops or shelves. Unit height is 1U (1.75 inches). An optional rack-mount adapter kit enables the installation of an FCD-E1 unit in a 19-inch rack.

FCD-E1 is cooled by free air convection, and does not include internal fans.

Figure 1-2. FCD-E1 Unit

1.3 Functional Description

Functional Block Diagram

Figure 1-3 shows the functional block diagram version of the FCD-E1 system. The FCD-E1 version shown in *Figure 1-3* has an electrical main link interface. However, the block diagram of the FCD-E1 version with optical interface is similar, except that the bypass bridge option and the associated relays cannot be installed. FCD-E1 includes several main subsystems:

- Chassis buses
- Main link interface
- User interface subsystem (Sublink, Data channel and Ethernet channel)
- Management subsystem
- Power supply subsystem.

The characteristics of the various subsystems are explained below.

Bus Functions

The FCD-E1 system performs its various functions by controlling the flow of data among the various user and main link interfaces in accordance with the application requirements.

The flow of data is performed through the FCD-E1 buses, as shown in *Figure 1-3*. FCD-E1 comprises several buses:

- TDM bus, which carries the data to the main link. The TDM bus serves as a highway through which all the information processed by the FCD-E1 flows. The information is deposited and collected in discrete time intervals, called timeslots (one timeslot supports a data rate of 64 kbps – see *Appendix C*). The TDM bus consists of two lines:
  - **TSER line** – carries the transmit data to the main link interface. The other interfaces deposit data on this line, in the timeslots specified by the management subsystem.
  - **RSER line** – carries the data received by the main link interface. The other interfaces read their data from the timeslots specified by the management subsystem.

Each FCD-E1 port deposits payload information received through its external interface on one TDM bus line, and simultaneously collects the information to be sent through the external interface from the other line. Therefore, considerable flexibility is available with respect to routing, because each port has access to all the payload information, and can be instructed by the management subsystem to read and write the desired information in the desired timeslots of the FCD-E1 TDM bus.

- Clock bus, which carries the various clock signals used by the FCD-E1 system. The FCD-E1 can lock its system clock (see the *Timing* section on page *1-6*) to various clock signals applied to its user ports, in accordance with the application requirements.
- Two management buses:
  - **Address bus** – carries routing information from the management subsystem to the other subsystems.
  - **Data Bus** – carries the internal management data.

Main Link Interface

The characteristics of the main interface are described in *Main Link* on page 1-2.

The main functions of the main link interface are described below.

Framer

The transmit path of the framer generates the E1 frame structure transmitted by the corresponding port, in accordance with the selected framing mode. The frame structure is generated by combining the data retrieved from the prescribed timeslots of the TSER line with the framing overhead. The TSER line may also carry inband management data generated by the management subsystem when the main link framing mode is G732S (G732N). Unused timeslots are filled with the idle code.

The receive path of the framer extracts the payload data, the inband management data stream and demultiplexes the incoming E1 data stream.

The framer also collects performance statistics based on framing errors and errors detected by the CRC-4 monitoring function, which can be read by the management subsystem through the module management subsystem.

When the main link is operated in the unframed mode, the framer is bypassed. As a result, the main link transparently transfers the data stream received from the data channel. Since in the unframed mode the data channel is configured for operation at a data rate of 2048 kbps, any other FCD-E1 ports must be disconnected from the main link.

LIU (Line Interface Unit)

This section describes in detail the operation of the LIU for the electrical main link interface. The functionality of the optical LIU is similar to that of the electrical LIU, except that the interface transmits and receives optical signals (see *Optical Main Link* on page *1-3*).

Transmit Path

The transmit path of the LIU includes an HDB3 coder, which converts the NRZ transmit data stream provided by the E1 framer to the line code specified for use on E1 links, and then generates the E1 transmit signal in accordance with ITU-T Rec. G.703.

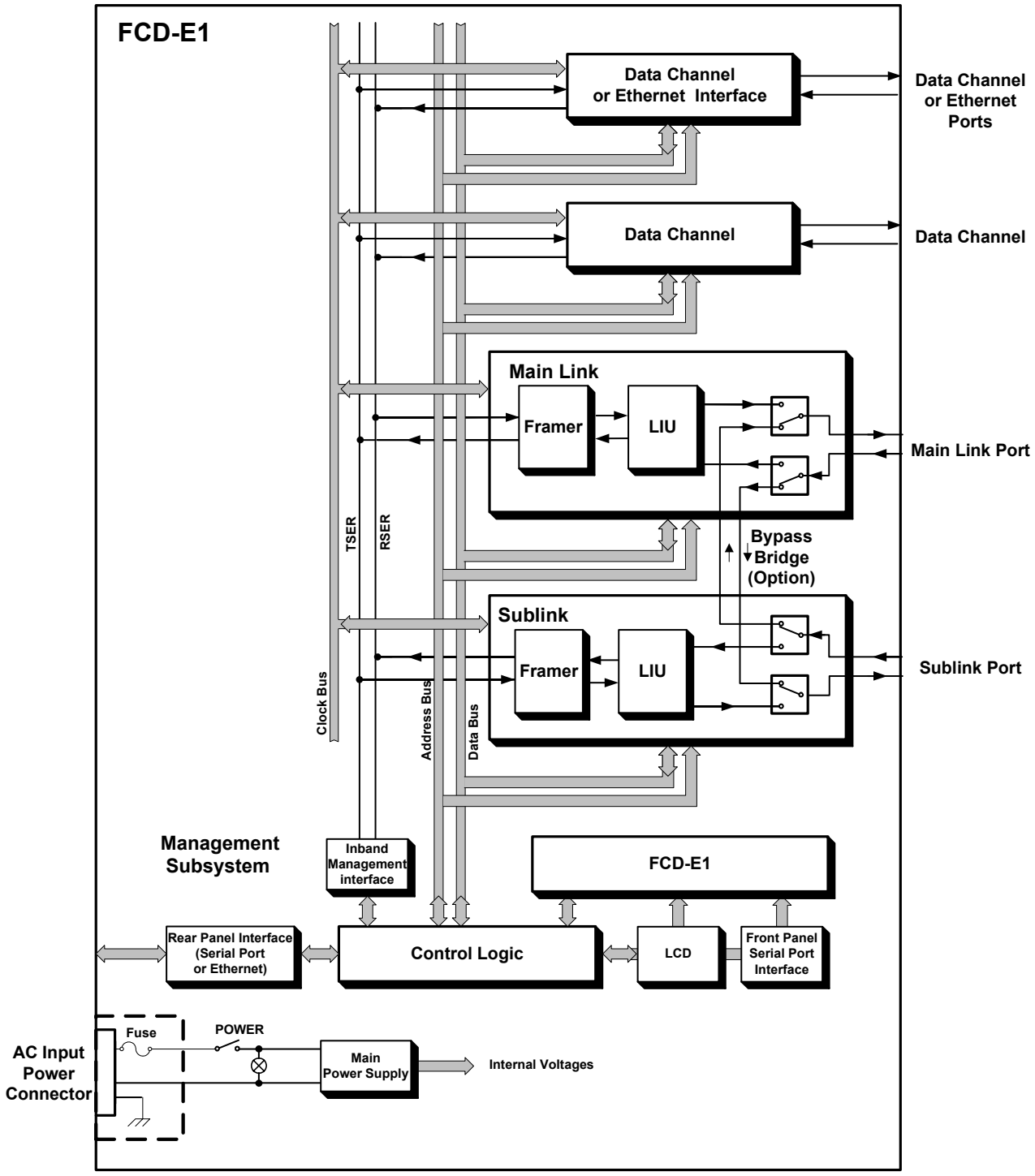


Figure 1-3. FCD-E1 Functional Block Diagram

Receive Path

The receive path of the LIU recovers the received E1 signal and the associated clock signal. The recovered clock signal is used by other module circuits, and is also applied on the clock bus. The recovered E1 signal is decoded by an HDB3 decoder, and sent to the receive path of the E1 framer in NRZ format.

The operating mode of the LIU receive path, DSU or LTU, is user-selectable.

The HDB3 decoder can provide performance statistics for evaluating line transmission quality when the CRC-4 option is not used, by collecting data on the bipolar violations (BPVs) detected in the incoming signal.

Bypass Relays

The bypass relays are normally energized, and connect the external E1 port lines to the LIU.

When FCD-E1 is not operating, the relays are deenergized, and take the position shown in *Figure 1-3*. In this case, for an FCD-E1 with a sublink, the transmit line of the main link is connected through the optional bypass bridge to the receive path of the sublink, and vice versa.

Notes

- *The bypass relays are available only on electrical main link interface boards.*
- *The bypass bridge is a narrow printed circuit board installed between the main link and sublink interface boards that plugs into special connectors located in the center of each board. The bypass bridge is an option available upon order.*
- *The bypass bridge interconnects only the balanced interfaces.*

The use of the bypass bridge is recommended when the FCD-E1 main and sublink carry inband management traffic destined to additional equipment within the network. This arrangement enables the management traffic to pass to the other equipment, irrespective of the state of the FCD-E1. Note however that the bypass option is useful only when the total attenuation of the lines connected in series does not exceed the maximum attenuation that can be compensated for by the other equipment.

Sublink Interface

The sublink interface is similar to the electrical main link interface, except that the direction of flow of signals is different where the sublink receive data is applied on the TSER line, and the sublink transmit data is collected from the RSER line.

The sublink interface is an option, installed in accordance with order.

Data Channels

The data channels operate as a synchronous port, which connects to the TDM bus via a bus interface. The data channels perform two main functions:

- In the output (receive) direction, the bus interface reads the payload data from the appropriate timeslots of the TSER line, under the control of the management subsystem, and generates a continuous n×56 kbps or n×64 kbps data stream. The data stream is accompanied by a clock signal derived from the internal FCD-E1 system clock.

  The transmit data and clock signals are then applied to the channel interface, which provides the interface to the external (user's) equipment. The interface can be ordered from one of the following options: RS-530, V.35, X.21, and V.36/RS-449.

- In the input (transmit) direction, the user's data applied to the input of the channel interface is placed in the appropriate timeslots of the RSER line, under the control of the management subsystem.

To enable synchronous operation, FIFO buffers are used to absorb small timing variations (jitter, wander, etc.). In all the data channel timing modes, the FIFO size is automatically selected in accordance with the data channel rate, as listed in *Table 1-2*. The values listed in *Table 1-2* are selected in accordance with the limits specified in the applicable standards.

In addition, when using the DTE2 mode, the FIFO size can also be manually selected, to enable the user to increase FIFO size when the jitter exceeds the expected limits.

Table 1-2. FIFO Size versus Data Channel Rate

Data Channel Rate (kbps)		FIFO Size (bits)
n × 56	**n × 64**	
56	64	±16
112 and 168	128 and 192	±30
224 through 448	256 through 512	±52
504 through 896	576 through 1024	±72
952 through 1792	1088 through 1792	±52
1848 and 1904	1856 and 1920	±30
1960	1984	±16

In addition to payload data, the data channel interfaces handle two additional types of signals:

- Clock signals. The direction of the clock signals depends on the data channel timing mode, DCE, DTE1, or DTE2. The timing modes are explained in the *Synchronous Data Port Timing* section on page *1-6*.

  In the DTE2 mode, the clock signal applied to the transmit input is connected to the clock bus and can be selected as an FCD-E1 system timing reference.
- Handshaking signals. The handshaking signals are used to control the exchange of signals with the user's equipment, in accordance with the protocol applying to the installed data channel interface. The handshaking is performed under the control of the management subsystem.
  The functions of the handshaking signals are explained in the *Data Channel Interfaces* section on page *1-4*.

Ethernet Interface

For description of the IR-ETH and IR-ETH/Q interfaces, refer to *Appendix E* and *Appendix F,* respectively.

The timing mode of the Ethernet channel interface is always DCE, that is, the timing of the receive and transmit paths is always locked to the FCD-E1 system clock.

Management Subsystem

The management subsystem controls the FCD-E1 operation, in accordance with its operating software. The basic capabilities of the management subsystem are presented in *Management* on page 1-7. The management subsystem also includes an SNMP agent, and a proprietary IP router for SNMP management traffic.

The management subsystem exchanges information and sends commands through several ports:

- The communication with the various internal subsystems of the FCD-E1 is performed through the management address and data buses. The subsystem also controls the front-panel indicators, and the rear-panel alarm relay.
- The communication with the supervision terminal is performed through the front panel RS-232 serial port interface. This port is used to perform the initial configuration of the FCD-E1, using any standard ASCII (“dumb”) terminal (or PC running a basic communication or terminal emulation program). After the initial configuration, the port can be used to control and monitor FCD-E1 operation.
- In addition to the front-panel serial port (CONTROL DCE), FCD-E1 has an additional port, located on the rear panel (CONTROL DTE). This port can be used as an alarm reporting port (connected through a dial-up modem link to a remote alarm monitoring terminal).
- When inband management is enabled, the management subsystem transmits and receives management traffic through the E1 ports. The communication with the E1 ports is made through the TDM bus.

Power Supply Subsystem

FCD-E1 can be powered by 100 to 240 VAC, 50/60 Hz, or by -48 VDC, in accordance with order. *Figure 1-3* shows an AC-powered FCD-E1:

- The AC input voltage passes through a protection fuse located in the AC input connector, and through the POWER on/off switch (the DC-powered FCD-E1 does not include a fuse). The POWER switch includes an internal indicator that lights when the FCD-E1 is turned on.
- The AC input voltage is applied to the main power supply voltage, which generates the regulated voltages required for the FCD-E1 internal circuits.

Timing Considerations

Main Link Timing Application

Figure 1-4 shows a typical application in which FCD-E1 is operated with the main link as the timing reference source, and illustrates the flow of timing signals within the system.

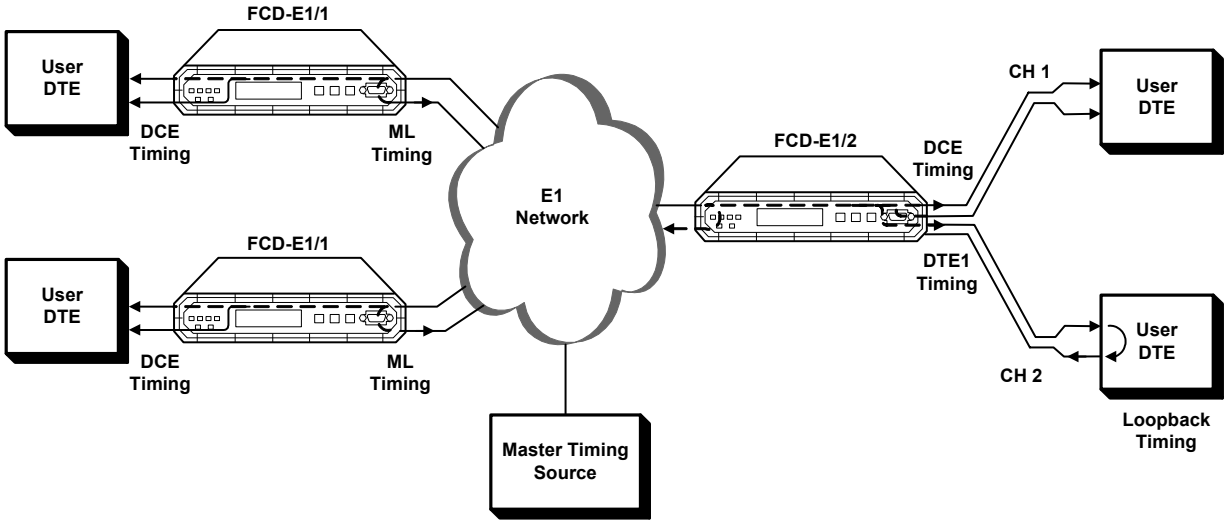


Figure 1-4. Main Link Timing, Flow of Timing Signals in a Typical Application

When using the main link as the timing reference, the data port must use DCE timing. However, DTE1 timing can also be used, provided the user's equipment connected to the data channels operates with loopback timing, that is, the user's equipment must lock its transmit clock to the receive clock provided by FCD-E1.

FIFO buffers are used on the data ports, to absorb small timing variations (jitter, wander, etc.). FIFO size is automatically selected in accordance with the data channel rate, as listed in *Table 1-2*.

The main link timing mode is particularly suitable for FCD-E1 units connected to an E1 network which has an accurate master timing source (e.g., PTT or national network), because it enables locking the timing of the equipment connected to the FCD-E1 units to the network timing.

Sublink Timing Application

Figure 1-5 shows a typical application, which uses the sublink as the timing reference source, and illustrates the flow of timing signals within the system.

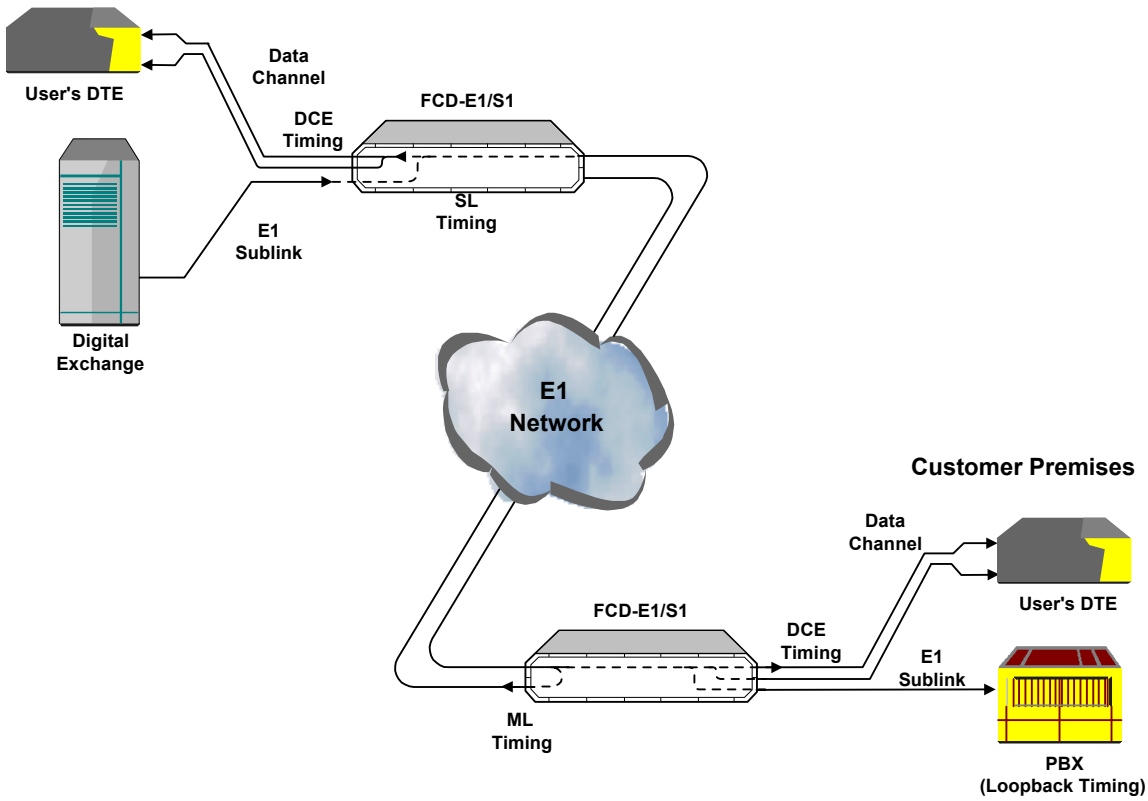


Figure 1-5. Sublink Timing, Flow of Timing Signals in a Typical Application

In the application shown in *Figure 1-5*, a PBX is connected by a fractional E1 trunk to a digital exchange, and must therefore use the exchange timing. For this purpose, the FCD-E1/S1 connected to the exchange uses the clock signal recovered from the sublink as the system timing reference, and the FCD-E1/S1 located on the customer's premises uses main link timing.

Therefore, the system timing of the FCD-E1/S1 located on the customer's premises is locked to the digital exchange timing. The exchange timing is thus transferred to the PBX located on the customer's premises.

Note that the data channels of the two FCD-E1 units must use DCE timing (or DTE1 timing, provided the user's equipment operates with loopback timing). This enables locking the timing of all the other equipment connected to the FCD-E1 units to the accurate timing source serving the digital exchange.

Data Channel Timing Application

Figure 1-6 shows a typical application which uses one of the data channels operating in the DTE2 timing mode, as the timing reference source, and illustrates the flow of timing signals within the system.

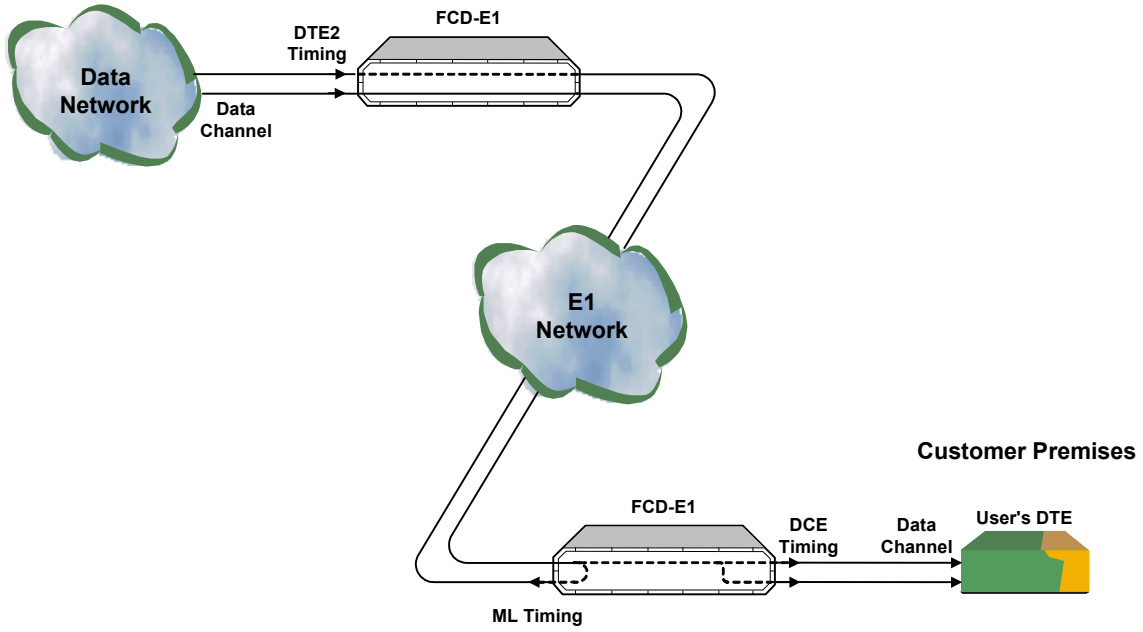


Figure 1-6. Data Channel Timing, Flow of Timing Signals in a Typical Application

In the application shown in *Figure 1-6,* the data equipment located on the customer's premises uses the FCD-E1 link to connect to a data network. Since data networks include accurate timing sources and do not accept data whose timing deviates significantly from the network timing, it is necessary to ensure that the equipment located on the customer's premises uses the data network timing.

For this purpose, the FCD-E1 connected to the data network uses the data channel as its timing source, and therefore its main link timing is locked to the data network timing.

The FCD-E1 located on the customer's premises uses main link timing. As a result, its system timing is also locked to the data network timing, and the network timing is transferred to the data equipment located on the customer's premises.

To optimize jitter performance, the FIFO size of a data channel operating in the DTE2 mode can be selected manually (±16 bits, ±30 bits, ±52 bits, or ±72 bits). The manually selected value cannot be less that the automatically selected value, which are listed in *Table 1-2*.

System Management Considerations

System Management Method

The FCD-E1 system is designed for unattended operation. The configuration of the FCD-E1 system, that is, a complete collection of operating parameters, is determined by a database stored in non-volatile memory located in the management subsystem. The database is automatically loaded upon FCD-E1 turn-on, thereby enabling the FCD-E1 to automatically return to its last operating configuration.

In addition, FCD-E1 stores a set of factory-default parameters, which can be used to start the configuration of a new FCD-E1 unit; the default parameters can also be loaded in case the user's database is corrupted.

FCD-E1 database management, as well as the other configuration, test, and monitoring activities (equipment status reading, alarm status and history, activation of test loops, reading of performance statistics, etc.) can be performed in three ways:

- **Supervision Terminal**. A "dumb" ASCII terminal (or a PC running a terminal emulation program), connected to the front-panel RS-232 serial ports of the management subsystem installed in the FCD-E1, can be used as a supervision terminal. The connection can be made either directly, or through modem or low-speed data links. The FCD-E1 system supports both point-to-point and multidrop connections.

  The program stored in the FCD-E1 management subsystem controls the supervision terminal.
- **SNMP Management.** The SNMP management capability enables fully graphical, user-friendly management using the RADview network management stations offered by RAD, as well as management by generic SNMP-based management systems.
- **Telnet**. Remote management is also possible using the Telnet communication protocol, which enables management using IP communication in parallel with the use of SNMP. Telnet support enables a remote IP host to control the operation of the FCD-E1 system, using functions identical to those provided by a supervision terminal.

When FCD-E1 includes the optional IP router, it is necessary to use a Telnet host to configure the router parameters and supervise its operation (see *Appendix F*).

Serial Port Interface Characteristics

The serial ports of FCD-E1 units have standard RS-232 asynchronous interfaces.

CONTROL DCE Port

All the FCD-E1 versions have a front-panel RS-232 port designated CONTROL DCE. This port enables direct connection to terminals, provided its interface is configured as DCE (the selection is made by software commands). Since terminals usually have DTE interfaces, the connection to the port is made by means of a straight-through cable.

The CONTROL DCE port also supports the connection of a remote supervision terminal through a modem link. For connection to a modem, you need a DCE/DTE cross cable (also called null modem cable). Refer to *Appendix A* for cable wiring information.

Two types of modems are supported:

- Dial-up Hayes™ compatible modems, e.g., the RAD miniature DLM/AT modem.
- Multidrop modems, e.g., the RAD SRM-6 miniature multidrop modem.

For multidrop operation, each FCD-E1 system can be assigned a node address in the range of 1 through 255. Assigning address 0 to a FCD-E1 system means that it

will accept and answer any message: this is not permitted in multidrop operation. Address 0 is however recommended for use with both point-to-point and dial-up modes.

CONTROL DTE Port

The other serial port, which is terminated in the connector designated CONTROL DTE, generally operates as a DTE interface and is intended for direct connection to a dial-up modem, for automatic reporting of alarms. This port does not support the connection of a supervision terminal.

Serial Port Communication Parameters

FCD-E1 can communicate with the supervision terminal or modem at rates of 300, 1200, 2400, 4800, 9600, or 19200 bps. Automatic data rate identification (Autobaud function) is also available. The word format consists of one start bit, 7 or 8 data bits, and one stop bit.

Parity can be odd, even or disabled. Always make sure the communication interfaces of the terminal/modem and the FCD-E1 are configured for operation with the same parameters.

Handshaking Protocol with Supervision Terminals

The handshaking between the FCD-E1 and the supervision terminal uses the control lines in the CONTROL DCE supervisory port connector. Since the interface mode is selected by software, the direction of the interface signals is the same in both the DCE and DTE mode, and a cross cable is required for the DTE mode.

The control lines being used in each mode, and the direction of the control signals, are detailed in the following chart.

Control Line	CONTROL DCE Interface Mode	
	DCE	**DTE**
CTS	Out	Not used
DCD	Out	Out
DSR	Out	Out
DTR	In	In
RTS	In	In

Data Terminal Ready (DTR)

The supervision terminal sets the DTR line ON (active) to gain control over the FCD-E1 and start a configuration/monitoring session.

When the DTR line is OFF (inactive), terminal control ends. If password protection is used, the password must be entered again the next time the DTR line is set ON to start a new session.

Request to Send (RTS)

The RTS line is normally ON (active) when the supervision terminal is in session.

When the RTS line is OFF (inactive), the FCD-E1 interprets any data received from the terminal on the TD line as MARK.

Clear to Send (CTS)

The state of the CTS line is determined by the CTS parameter:

ON The CTS line is always ON (active).

=RTS The CTS line follows the RTS line.

Data Carrier Detect (DCD)

The state of the DCD line depends on the communication address (node number):

- When the node address is 0, the DCD line is always ON (active).
- When a non-zero node address is used, the DCD line becomes ON (active) when data is detected on the RD line, provided the FCD-E1 recognizes its own address in the data stream.

To simulate DTE operation, the delay between these events can be set by the user (by means of the DCD-DELAY parameter).

Data Set Ready (DSR)

- Usually, the DSR line is configured to follow the DTR line. In this case, if the supervisory port interface is DTE, the DSR line will be set to ON for 5 seconds when the RI line is ON while the DTR line is OFF.
- If the supervisory port interface is DCE, the DSR line can also be configured to be continuously ON. However, if the DTR line switches to OFF, the DSR line will also switch to OFF for 5 seconds.

In addition, the FCD-E1 always sets DSR OFF (inactive) for 5 seconds when the EXIT command is executed, or the disconnect time-out expires.

Handshaking Protocol with Dial-up Modem

The dial-out mode in the FCD-E1 is supported by both the CONTROL DTE port and CONTROL DCE port (the latter only when using a DCE/DTE cross-cable).

The handshaking procedure between the FCD-E1 and a dial-up modem uses the control signals in the CONTROL DTE/CONTROL DCE connector. The procedure is essentially similar to the handshaking with a terminal, except the directions of the control signals are reversed relative to their direction in the CONTROL DCE connector.

The control lines and the direction of the control signals in the CONTROL DCE and CONTROL DTE connectors are detailed in the following chart.

Control Line	Connector	
	CONTROL DCE	CONTROL DTE
CTS	Out	In
DCD	Out	In
DSR	In	In
DTR	Out	Out
RI	Not used	In
RTS	In	Out

AUTOBAUD Function

When the AUTOBAUD function is enabled, the FCD-E1 can identify the data rate of the signal received at the CONTROL DCE port by analyzing the timing of three consecutive Carriage Return + Line Feed characters (generated by pressing three times the **<Enter>** key). The detected data rate is then used for the current communication session.

Note *The data rate used by the CONTROL port is always equal to the data rate configured by the user, and therefore it need not be equal to the data rate used at the CONTROL DCE port.*

The automatic baud rate identification procedure is performed (or repeated) whenever three consecutive carriage returns are received after one of the following events occurs:

- The DTR line has been switched OFF.
- The EXIT command has been executed.
- The idle disconnect time-out expired because no data has been exchanged with the supervision terminal.

In case one of these events occurred, FCD-E1 assumes that the current communication session has been terminated. Therefore, when the password protection is enabled, the password must be entered again before the supervision communication with the FCD-E1 can be resumed.

The AUTOBAUD function is supported only by the CONTROL DCE port, and must not be used when SLIP or PPP communication is desired.

SNMP and Telnet Management Access Options

The control subsystem of FCD-E1 systems supports both out-of-band and inband management access.

- For out-of-band management, the connection is made through one of the FCD-E1 serial or Ethernet ports. For serial ports, the user can select either the SLIP (Serial Link IP) or the PPP (Point-to-Point) protocol; Ethernet ports support the IP and ARP protocols. Both serial and Ethernet ports support the RIP2 routing protocol.
- Inband management is available for the main link and sublink. See *Appendix B* for details.

Supervision Terminal Capabilities

The supervision terminal provides a simple, command line based human interface. The terminals can communicate with the managed FCD-E1 systems via the CONTROL DCE serial RS-232 communication ports.

The serial port is generally configured as a DCE port, for direct connection to a terminal, but can also operate as a DTE port when it is necessary to connect the terminal via a modem link, or a low-speed data multiplexer channel. Thus, a remote operator located at a central site can perform all the functions available from a supervision terminal directly connected to the FCD-E1 system. Optional password protection is also available.

The communication data rate of the serial port can be selected in accordance with system requirements (300, 1200, 2400, 4800, 9600, or 19200 bps). Automatic data rate identification (autobaud function) is also available. Data word format is configurable (one start bit, seven or eight data bits, selectable parity (odd, even, or none), and one stop bit).

Since continuous communication with the FCD-E1 system is necessary only when management activities are actually performed, one terminal can manage multiple FCD-E1 units using a polling protocol, with the connection to the individual units being made by means of multi-drop modems or digital sharing devices. For polling purposes, each FCD-E1 can be assigned an eight-bit address, for a maximum of 255 nodes (the zero address is reserved for non-polled communication).

SNMP Management Capabilities

The FCD-E1 system includes an SNMP agent that can communicate out-of-band and/or inband through the dedicated management router of the FCD-E1 system. To permit SNMP management, the SNMP agent must be configured and enabled by the user. *Appendix B* provides information on the required parameters.

A basic management topology is shown in *Figure 1-7*. In this example, a network management station is attached to an Ethernet LAN. A remote access LAN extender, MBE-RAS/A, is located near the managed equipment (e.g., FCD-E1, MEGAPLEX-2100(*), etc.), and its serial ports are connected via cables to the serial port of the FCD-E1 CONTROL DCE connector using the SLIP protocol.

The MBE-RAS extender can connect up to 8 FCD-E1 devices to one management system.

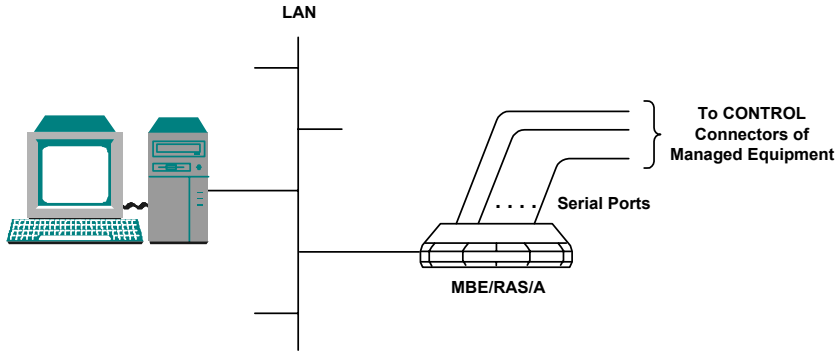


Figure 1-7. Basic Management Topology Using Network Management Station Attached to LAN

The dedicated management traffic routers of the FCD-E1 systems, and of the other RAD equipment, are able to determine network topology in accordance with the capabilities of the routing algorithm, without requiring the user to provide a priori topology information on the network. Moreover, the routing algorithm also supports automatic switching to an alternate route in case the currently selected route fails. The dedicated router operates on the inband traffic; the user can also enable the routing of out-of-band traffic.

Combining Inband and Out-of-Band Management Capabilities

The advanced capabilities of the FCD-E1 SNMP agents allow easy integration of the FCD-E1 system in wide-area managed communication systems. Its capabilities support any practical communication network topology, as illustrated in the example shown in *Figure 1-8*.

In *Figure 1-8* the network management station attached to the FCD-E1 system can manage, using inband communication over the user-selected links, all the units (another FCD-E1 unit, and several Megaplex-2100 units), connected to the remote ends of the corresponding links. Thus, an entire wide-area network can be managed by means of a network management station connected to any FCD-E1 unit (or to any of the other RAD equipment, which supports SNMP management).

Remote Management using Telnet over IP

The FCD-E1 system supports the Telnet communication protocol, which enables any IP host to access the FCD-E1 system supervision facility using TCP/IP communication. The Telnet user has access to the same command-line interface that is available to the user of a supervision terminal, however it uses the management topologies described above for SNMP.

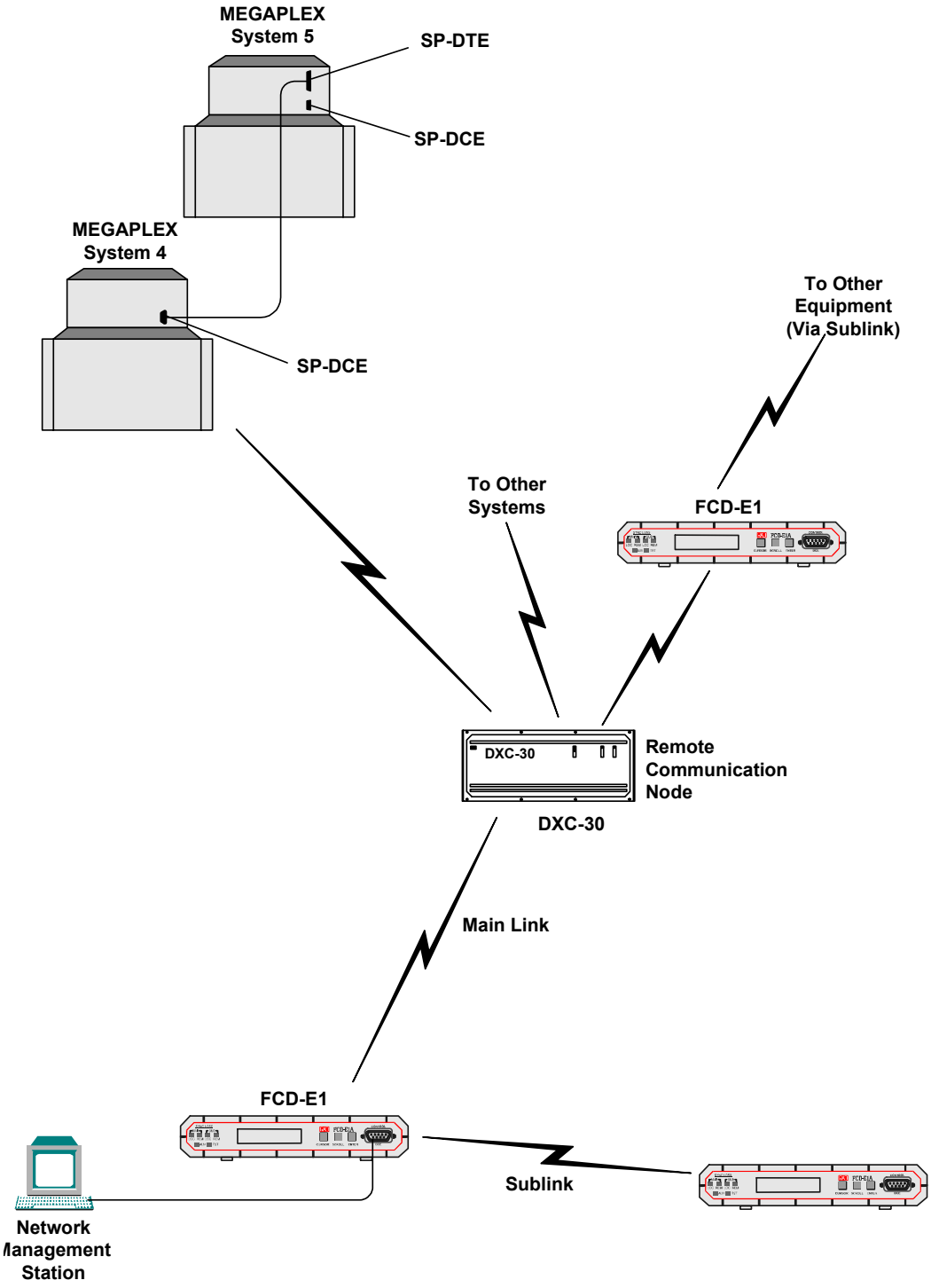


Figure 1-8. Extended Management Topology Using Network Management Stations

Prevention of Access Conflicts

The FCD-E1 system has a dedicated mechanism that prevents access conflicts when more than one management mode is active.

Table 1-3 lists FCD-E1 response to multiple-access conditions.

Table 1-3. Handling of Management Access Conflicts

Type of First Access	Response to Second Access		
	Telnet Inband	Telnet Out-of-Band	Supervision Terminal
Telnet Inband	Message	Ignored	Message
Telnet Out-of-Band	Message	Ignored	Ignored
Supervision Terminal	Disconnects the terminal	Not possible	Ignored

Alarm Collection

The FCD-E1 system stores alarms detected during its operation in a buffer that can hold up to 100 alarms. Status indicators located on the front panel of the FCD-E1 enclosure and on the management subsystems indicate the presence of an alarm condition. Separate indications are provided for major and minor alarms.

Alarm Relay

In addition, the FCD-E1 system has an alarm relay that enables the activation of bay alarms, remote indication of alarms, etc. The alarm relay is energized when the FCD-E1 system is powered and operating normally, and is de-energized when FCD-E1 system power is off. In addition, the user can select the state of the relay contacts (closed or open) for each individual alarm condition.

The alarm relay has a pair of change-over dry contacts: the normally-open (NO) contacts close in case of alarm, and the normally-closed (NC) contacts open in case of alarm. The alarm contacts are floating with respect to the signal and chassis grounds of the FCD-E1.

The alarm contacts can be connected, by means of jumpers, in the place of the DCD and CTS lines in the rear panel CONTROL DTE port. Therefore, the CONTROL DTE port can still be used for connecting via modems to the FCD-E1, provided it is not used for polled communication. The alarms that result in the activation of the alarm relay are as follows:

- Loss of power (indicated by the NO contacts).
- Detection of a hardware failure, and any other failure, during the power-up self-test.
- Detection of real-time clock battery failure during the power-up self-test.
- Detection of a disruption in the database during the power-up self-test.
- Duplicate system name detected in the managed network.
- Signal loss, excessive bit error rate, excessive rate of bipolar violations, loss of local or remote frame or multiframe synchronization, and/or reception of AIS on the main link or on the sublink.
- Management link down.

The relay returns automatically to the no-alarm state when none of the alarm conditions listed above is present.

Alarm Reporting

The alarms stored in the FCD-E1 alarm buffer can be transmitted automatically through the serial management access ports, for display on a supervision terminal; when SNMP management is used, alarms are also sent to user-selected management stations as traps.

FCD-E1 with two RS-232 interfaces has an additional serial port that can be configured to operate as a dial-out port, for automatic reporting of alarms to remote locations. This port is intended for connection to a Hayes™ or Hayes-compatible dial-up modem. The user, in accordance with the following options can program the reporting method:

- Always send a report whenever a new alarm condition is detected.
- Send a report only upon the detection of a major alarm.
- Reporting disabled (no dial-out function).

When it is necessary to report an alarm condition, the FCD-E1 system initiates the call set up, and then, after the destination answers, sends the complete contents of the alarm buffer. Following the transmission of the alarm buffer contents, the FCD-E1 system disconnects automatically.

To increase reporting reliability, the user can define the number of dialing retries, and an alternate directory number to be called in case the primary directory number cannot be reached. If nevertheless the call cannot be established, the full contents of the buffer will be sent the next time a call is set up.

To expedite the handling of alarms and reduce the information load during system malfunctions, the system operator can mask alarm conditions, to prevent continuous reporting of known alarm conditions, e.g., during maintenance activities.

1.4 Technical Specifications

Electrical E1 Main Link and Sublink

Framing	• G732N, 2 frames per multiframe, CRC-4 option disabled • G732N, 2 frames per multiframe, CRC-4 option enabled • G732S, 16 frames per multiframe, CRC-4 option disabled • G732S, 16 frames per multiframe, CRC-4 option enabled • Unframed (main link only)
Bit Rate	2.048 Mbps
Line Code	HDB3
Line Impedance	
Balanced interface	120Ω
Unbalanced interface	75Ω

Signal Levels	
Transmit level	
Balanced Interface	±3V ±10%
Unbalanced Interface	±2.37V ±10%
Receive level	
LTU mode	0 to –36 dB
DSU mode	0 to –10 dB
Jitter Performance	Per ITU-T Rec. G.823
Connectors	
Balanced interface	RJ-45 (ISO 10173) 8-pin connector
Unbalanced interface	Two BNC coaxial connectors
Main Link Timing	
Receive timing	Always recovered from received data signal
Transmit timing (user-selectable)	
Internal	±50 ppm oscillator
External timing	Locked to the transmit clock of a selected synchronous channel, or to the receive sublink timing, or to the receive main link
Loopback timing	Locked to the recovered receive clock, allowed range ±130 ppm
Sublink Timing	
Receive timing	Always recovered from the received data signal
Transmit timing	Locked to the FCD-E1 transmit timing or to the main link transmit clock

Optical E1 Main Link

Framing	• G732N, 2 frames per multiframe, CRC-4 option disabled • G732N, 2 frames per multiframe, CRC-4 option enabled • G732S, 16 frames per multiframe, CRC-4 option disabled • G732S, 16 frames per multiframe, CRC-4 option enabled • Unframed
Bit Rate	2.048 Mbps

	Line Code	HDB3
	Range	See *Table 1-1*.
	Connectors	ST, SC or FC/PC, in accordance with order
Synchronous User Data Channel	*Data Port Interface*	V.35, X.21, V.36/RS-449, or RS-530, according to order
	Data Port Connectors	• RS-530 interface: 25-pin D-type female • V.35 interface: 34-pin female via adapter cable • V.36/RS-449 interface: 37-pin D-type female via adapter cable • X.21 interface: 15-pin, D-type female via adapter cable
	Bit Rates	$n \times 56$ kbps or $n \times 64$ kbps, where n equals 1, 2, 3, ..., 31 ***Note***: Data channel 2 will work with $n \times 56$ kbps only if data channel 1 is configured to $n \times 56$ kbps
	Timing Modes	
	DCE	Receive and transmit clocks to the synchronous DTE
	DTE1	Receive clock to the synchronous device, and transmit clock from the synchronous device
	DTE2	Receive and transmit clock from the synchronous DCE
	Control Signals	• CTS follows RTS or constantly ON, software selectable • DSR constantly ON, except during the remote main link loopback • DCD constantly ON, except during loss of synchronization alarm
	Timeslot allocation	• Sequential timeslots (bundled) • User defined
Ethernet Ports	For technical specifications of the IR-ETH and IR-ETH/Q interfaces, refer to *Appendix E* and *Appendix F*, respectively.	

Diagnostics

Test Loops	• E1 main link local analog loopback, towards the local DTE • E1 main link local digital loopback, towards the local DTE • E1 main link remote analog loopback, towards the remote DTE • Channel loopback, towards the remote DTE • Channel loopback, towards the local DTE • E1 sublink remote digital loopback, towards the remote DTE • E1 sublink local analog loopback, towards the local DTE • E1 sublink remote analog loopback, towards the remote DTE • BER test for each data port individually • Inband code-activated loopback per data port
Note	*No loopback can be activated for the Ethernet interfaces.*
Statistics	• Per ITU-T Rec. G.706 when CRC-4 is enabled • OOS and BPV statistics without CRC-4

Supervisory Ports

Inband Management	SNMP and Telnet supported inband, using the S_a bits or a dedicated timeslot (Frame Relay or proprietary protocol)
Out-of-Band Ports	• Front-panel CONTROL DCE port • Rear-panel CONTROL DTE port
CONTROL DCE Functions	Full control over FCD-E1 operation using supervision ("dumb") terminal, SNMP (SLIP), or Telnet (SLIP), dial-out, dial-in using a modem
CONTROL DTE Functions	Dial-out only
Port interfaces	V.24/RS-232 (asynchronous)
Port connectors	9-pin D-type female
Data rates	
CONTROL DCE port	300, 1200, 2400, 4800, 9600, or 19200 bps, with automatic detection of data rate (Autobaud)
CONTROL DTE port	300, 1200, 2400, 4800, or 9600, without Autobaud
Data word format	• One start bit • 7 or 8 data bits • Even, odd, or no parity • One stop bit

	Dial-in capabilities (CONTROL DCE port)	Supports all the supervisory port functions
	Dial-out capabilities (CONTROL DTE and CONTROL DCE ports)	Event-activated; can control a dial-up (Hayes™-compatible) modem to dial a pre-programmed number in case of an alarm event
	Alarm Buffer	Alarm buffer size: 100 alarms
	Alarm Relay	Three pins available on the CONTROL DTE port.
	Function	Floating change-over contacts
	Contact Ratings	• Open contacts: maximum 60 VDC • Closed contacts: maximum 1A
Controls	*Liquid Crystal Display*	2 rows of 16 characters
	Push Buttons	CURSOR, SCROLL, ENTER
	Front Panel Indicators	SYNC LOSS LOC: Loss of local synchronization alarm on the main link (MAIN) and sublink (SUB) (red) SYNC LOSS REM: Loss of remote synchronization alarm on the main link (MAIN) and sublink (SUB) (red) TEST: test active (yellow) ALARM: alarm indication (red)
	Rear Panel Ethernet Interface Indicators	For the IR-ETH and IR-ETH/Q interfaces, refer to *Appendix E* and *Appendix F*, respectively.
Physical Characteristics	*Height*	4.37 cm / 1.7 in (1U)
	Width	21.5 cm / 8.5 in
	Depth	24.3 cm / 9.5 in
	Weight	1.3 kg / 2.9 lb
Power Requirements	*Supply Voltage*	
	AC Source	100 to 240 VAC, 50/60 Hz
	DC Source	–48 VDC nominal (–40 to –57 VDC)
	Power Consumption	10W
Environment	*Operating Temperature*	0° to 50°C / 32° to 122°F
	Relative Humidity	Up to 90%, non-condensing

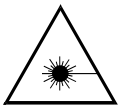
Chapter 2
Installation and Setup

2.1 Introduction

This chapter provides instructions for mechanical and electrical installation of the FCD-E1 unit.

Warning

Before performing any internal settings, adjustment, maintenance, or repairs, first disconnect all the cables from FCD-E1.
No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by a skilled technician who is aware of the hazards involved.
Always observe standard safety precautions during installation, operation, and maintenance of this product.



Warning

FCD-E1 units with fiber-optic main link interface may include Class 1 lasers.
For your safety:
Do not look directly into the optical connectors while the FCD-E1 is operating.
Do not attempt to adjust the laser drive current.
The use of optical instruments with this product will increase eye hazard. Laser power up to 1 mW at 1310 nm and 1550 nm could be collected by an optical instrument.
Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

ATTENTION: The laser beam is invisible.

Note *Before installing the product, review* Handling Energized Products *at the beginning of the manual.*

2.2 Site Requirements and Prerequisites

AC-powered FCD-E1 units should be installed within 1.5m (5 feet) of an easily accessible grounded AC outlet capable of furnishing the required supply voltage (100 to 240 VAC).

DC-powered FCD-E1 units require a –48 VDC (–40 to –57 VDC) power source. The power source must be adequately isolated from the mains supply.

- Allow at least 90 cm (36 inches) of frontal clearance for operating and maintenance accessibility.

- Allow at least 10 cm (4 inches) clearance at the rear of the unit for signal lines and interface cables.

The ambient operating temperature of FCD-E1 is 0 to 50°C (32 to 122°F), at a relative humidity of up to 90%, non-condensing.

The FCD-E1 units are cooled by free-air convection, therefore in rack installations it is necessary to leave sufficient space (at least 1U) above and below each unit, to enable free airflow.

Electromagnetic Compatibility Considerations

The FCD-E1 is designed to comply with various electromagnetic compatibility (EMC) standards. To meet these standards, it is necessary to connect the FCD-E1 case to a low-resistance grounding system.

2.3 Package Contents

The FCD-E1 package includes the following items:

- FCD-E1 unit
- Multiservice Access Devices and Intelligent CLEs CD-ROM
- AC power cord or DC power supply connector kit
- RM kit (if ordered)
- Interface adapter cable(s), in accordance with order (see *Connecting the Synchronous Data Channel* on page 2-17).

2.4 Equipment Needed

FCD-E1 is a standalone device intended for tabletop or bench installation. It is delivered completely assembled. No provision is made for bolting the unit on the tabletop. For installation of one or two units in a 19-inch rack, refer to the *Rack Mounting Kit for 19-inch Racks* guide that comes with the RM kit.

➤ **To complete the installation of FCD-E1:**

1. Determine the required configuration of FCD-E1, according to your application and set the internal jumpers and switches accordingly.
2. Connect the E1 sublink, main link, data channels and the CONTROL DCE port, if necessary.
3. Connect power to the unit.

2.5 Setting the Internal Jumpers and Switches

This section provides information on the functions of the internal jumpers and switches, to help you select the correct setting for your particular application, and gives step-by-step instructions for performing the internal settings. The default settings are also listed.

All the other configuration actions can be performed from the front panel, from a supervision terminal, or from a network management station after the installation is completed. Information and detailed instructions for these operations appear in the *Chapter 3* and *Chapter 4*.

Warning

Electrical Shock Hazard
Access to the inside of the unit is permitted only to qualified and authorized service personnel.
Disconnect the unit from the power line and from all the cables before removing cover.
Line voltages are present inside the FCD-E1 when it is connected to power and/or to the lines. Moreover, under certain fault conditions dangerous voltages may appear on the lines connected to the FCD-E1.
Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled technician who is aware of the hazard involved.
Capacitors inside the instrument may still be charged even after the instrument has been disconnected from its source of supply.

Caution FCD-E1 contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components, and before moving jumpers, touch the FCD-E1 frame.

FCD-E1 Printed Circuit Boards

The type and number of printed circuit boards of FCD-E1 depends on the specific version. *Figure 2-1* identifies the boards installed in each FCD-E1 version.

All the FCD-E1 versions include a common main board. The main board includes the common signal processing circuits, and the interfaces of the main link and data channel 1.

- The FCD-E1 versions with a second data channel have an additional interface board, for data channel 2 or Ethernet LAN interface. This board does not include user jumpers.
- The FCD-E1 versions with a sublink have a sublink interface board. This board includes user jumpers; in addition, when changing the main link interface from balanced to unbalanced, it is necessary to temporarily remove this board to gain access to the jumpers located on the main board.

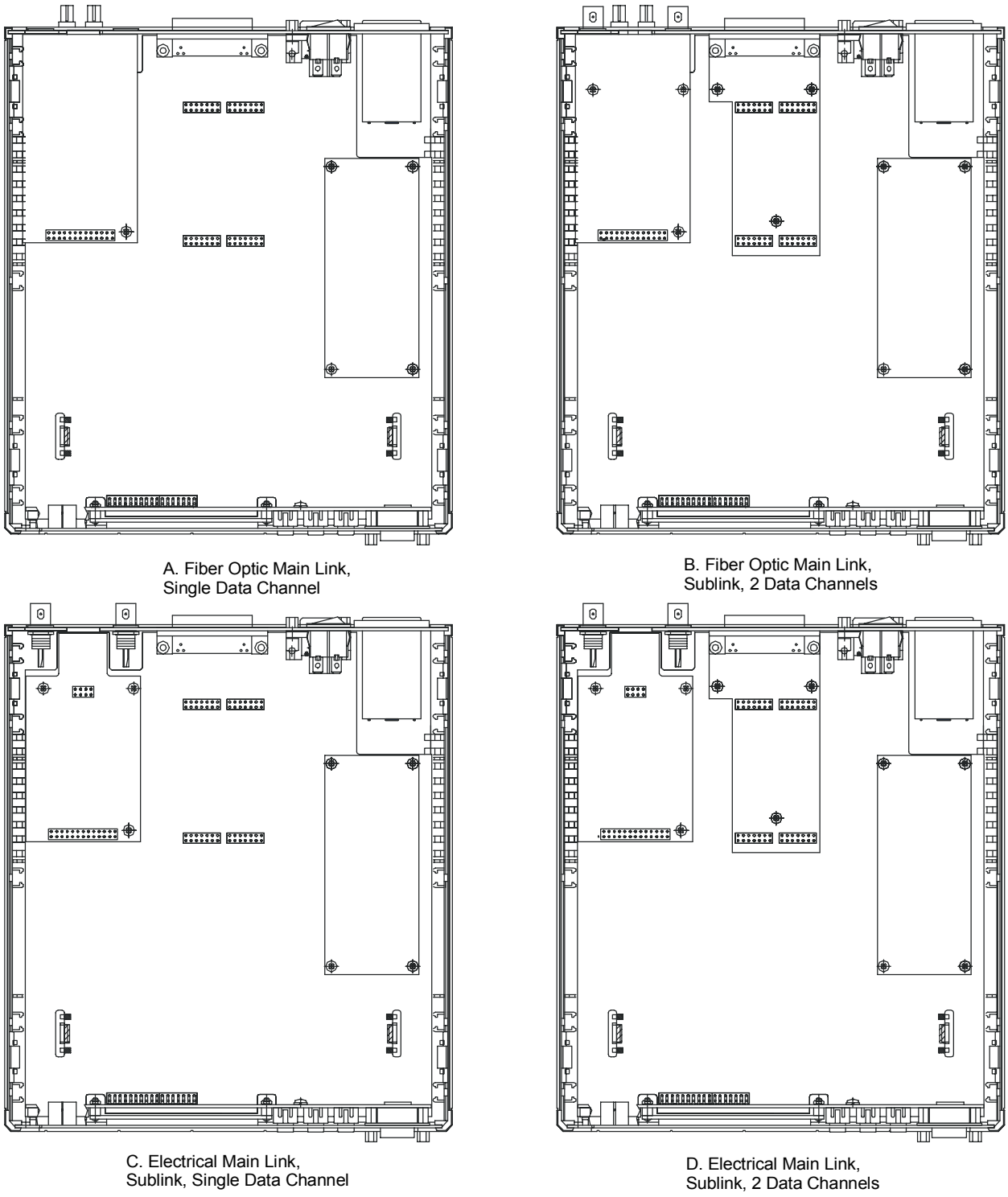

A. Fiber Optic Main Link,
Single Data Channel
B. Fiber Optic Main Link,
Sublink, 2 Data Channels
C. Electrical Main Link,
Sublink, Single Data Channel
D. Electrical Main Link,
Sublink, 2 Data Channels

Figure 2-1. Identifying the FCD-E1 Boards

Opening the FCD-E1 Case

To reach the internal jumpers and switches of the FCD-E1, it is necessary to open its case. The case cover is held by four screws, identified in *Figure 2-2*. After removing the screws, the cover can be removed.

Follow these steps:

1. Disconnect all the cables connected to the FCD-E1.
2. Refer to *Figure 2-2*, turn the unit over, and unscrew the four cover screws. Keep the screws in a safe place.
3. After the four screws are released, remove FCD-E1 top cover by pulling it straight up.

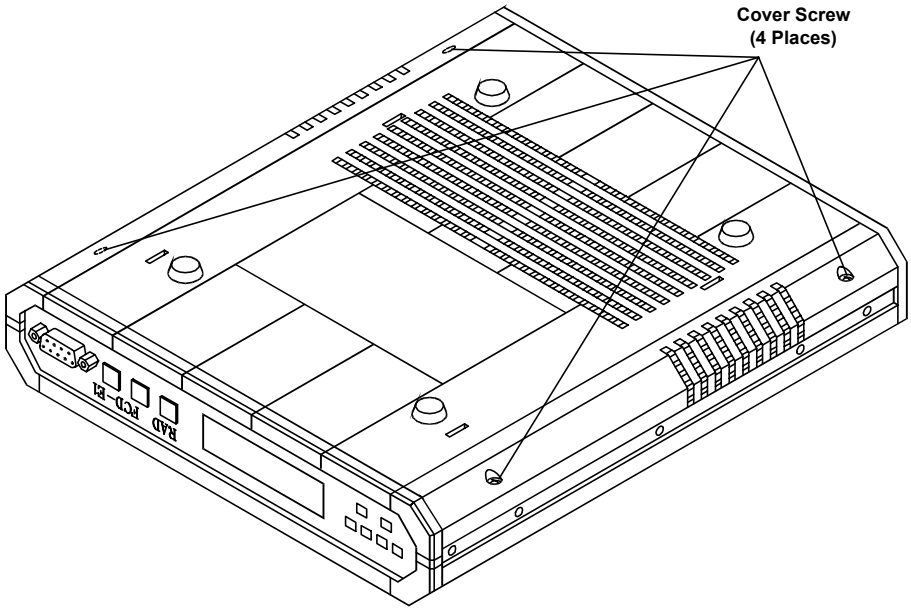


Figure 2-2. Identification of Cover Screws

Main Board Settings

The jumpers and switches located on the FCD-E1 main board with E1-DSU interface are identified in *Figure 2-3*. The jumpers and switches located on the FCD-E1 main board with E1-LTU interface are identified in *Figure 2-4*. Their functions are described in *Table 2-1*.

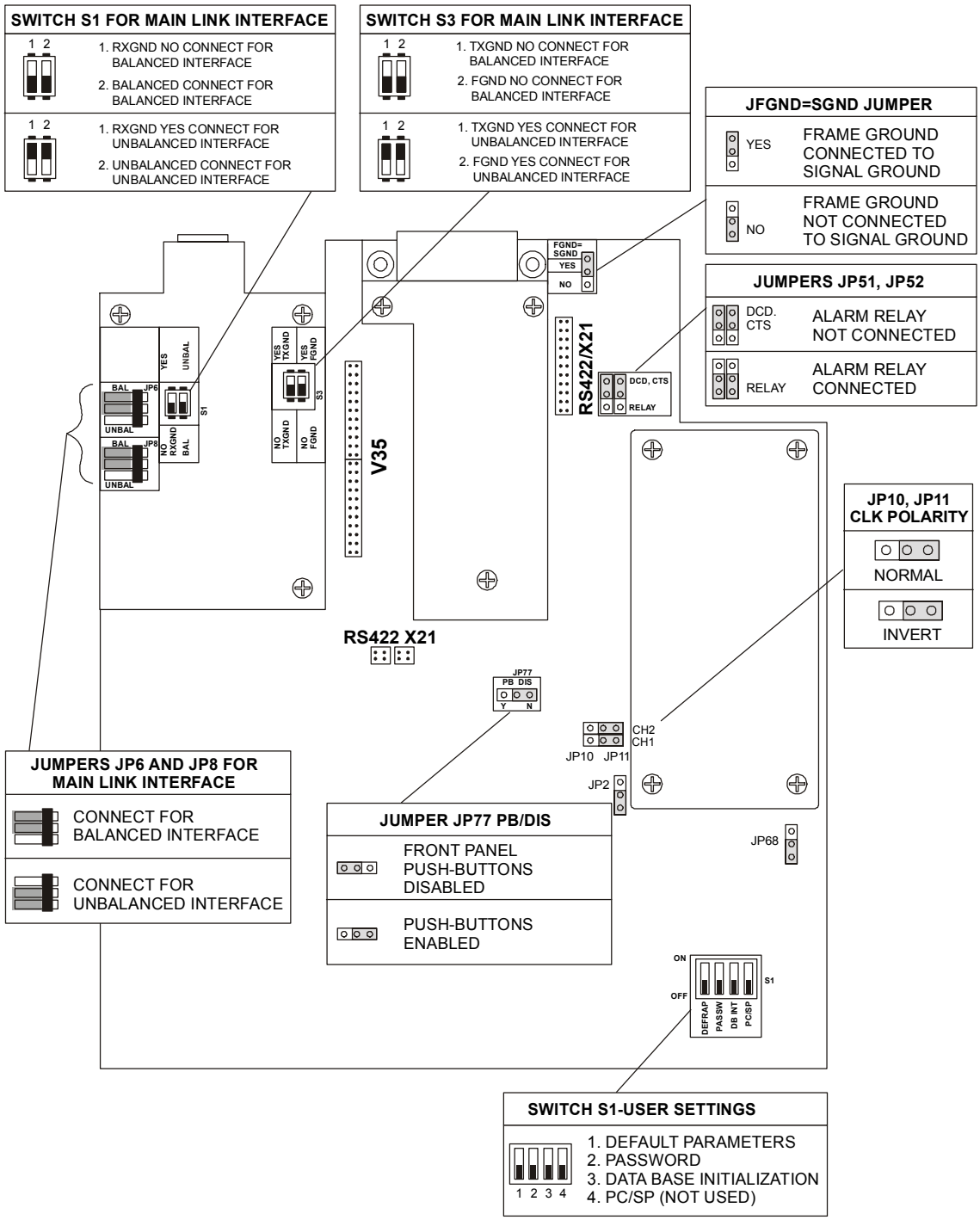


Figure 2-3. FCD-E1/DSU Main Board Internal Settings

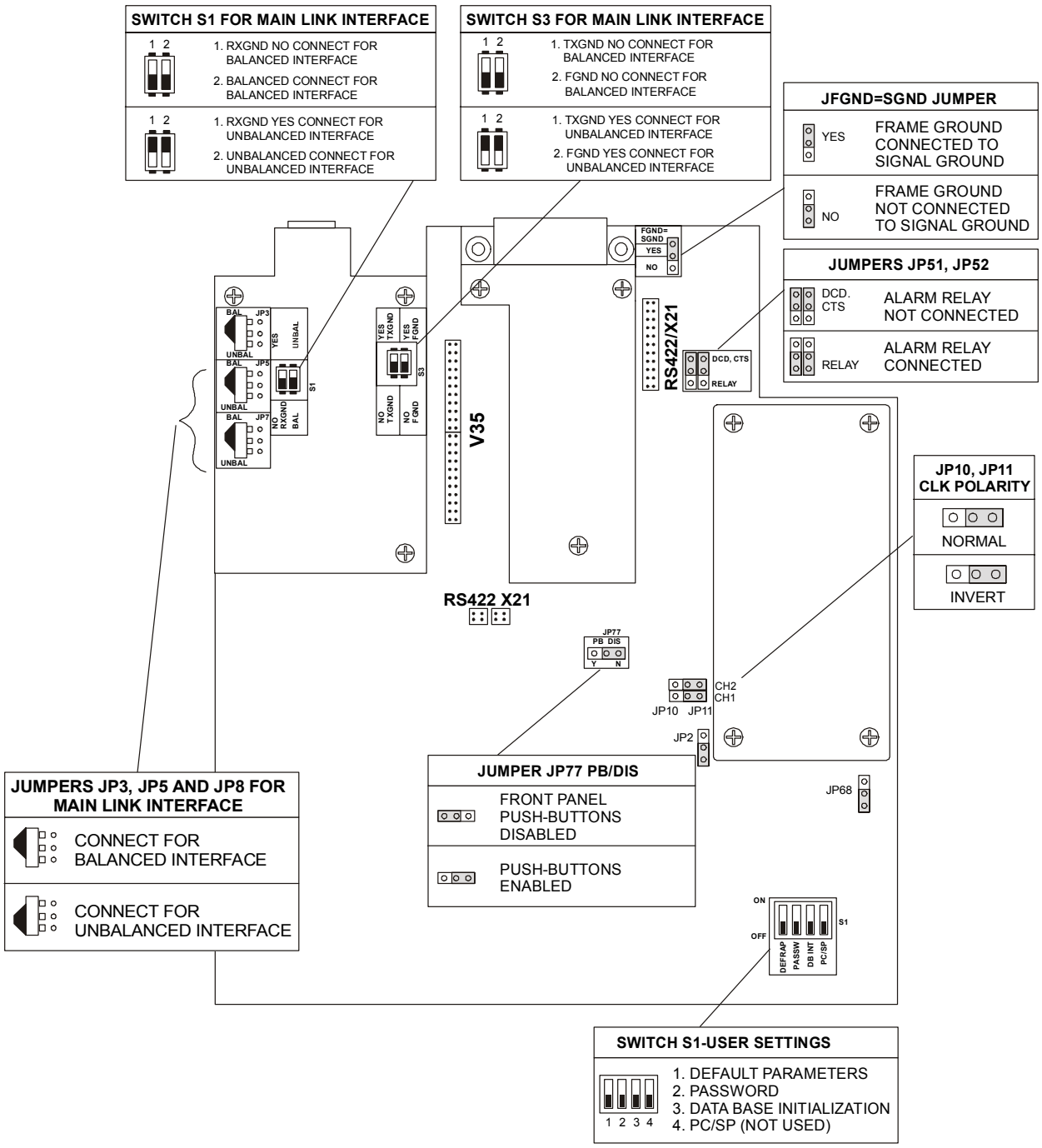


Figure 2-4. FCD-E1/LTU Main Board Internal Settings

Table 2-1. Main Link Jumper and Switch Settings

Function	Jumper or Switch	Description	Values (Default value in bold)
Main Link Interface Board Settings			
Ground	JP8	The jumper FGND=SGND controls the connection between the FCD-E1 signal ground and the frame (chassis) ground.	**YES –** Signal ground is connected to frame (chassis) ground. NO **–** Signal ground is not connected to the frame ground.
Balanced / Unbalanced Interface	JP6, JP8 and switch S1 (2)	Jumpers JP6, JP8 and switch S1 (2) designated for BAL/UNBAL on the E1-DSU interface are used to select the main link interface. ***All the jumpers must always be set to the same position***.	**Balanced Interface -** Set all the jumpers to BAL. Unbalanced Interface **-** Set the jumpers to UNBAL (UNB)
	JP3, JP5, JP7, and switch S1 (2)	Jumpers JP3, JP5, JP7,and switch S1 (2) designated for BAL/UNBAL on the E1-DSU interface are used to select the main link interface. ***All the jumpers must always be set to the same position***.	**Balanced Interface -** Set all the jumpers to BAL. Unbalanced Interface **-** Set the jumpers to UNBAL (UNB).
Transmit Side Ground Reference	TXGND S3 (1)	The TXGND jumper is used to control the ground reference of the main link transmit output when the unbalanced interface is used.	YES – Transmit ground reference is connected to frame (chassis) ground. **NO –** Transmit ground reference is not connected to the frame ground. (Balanced interface) In accordance with ITU-T recommendations, the jumper should be set at YES when the unbalanced interface is used.

Table 2-1. Main Link Jumper and Switch Settings (Cont.)

Function	Jumper or Switch	Description	Values (Default value in bold)
Receive Side Ground Reference	RXGND S1 (1)	The RXGND jumper is used to control the ground reference of the main link receive input when the unbalanced interface is used.	YES – Receive ground reference is connected to frame (chassis) ground. **NO –** Receive ground reference is not connected to the frame ground. (Balanced interface) In accordance with ITU-T recommendations, this jumper should be set to YES when the unbalanced interface is used.
Alarm Relay	JP51, JP52	The jumpers JP51 and JP52 are used to connect the alarm relay contacts to the rear panel CONTROL DTE connector. ***Both jumpers must always be set to the same position***.	RELAY – The alarm relay contacts are connected instead of the DCD and CTS lines in the CONTROL DTE connector. The other supervisory port interface lines in the CONTROL DTE connector remain connected, and enable connecting the port to modem links, but do not allow polled communication. **DCD, CTS –** The alarm relay is not connected. The CONTROL DTE connector provides full functionality.
Push-button Disable	Jumper PB DIS JP77	To prevent unauthorized personnel from using the front panel pushbuttons, and possibly disrupting normal equipment operation, disable these pushbuttons by connecting jumper PB DIS (installing jumper over both pins).	Connected –The front panel pushbuttons are disabled. **Disconnected –** The front panel push buttons are enabled, and can be used to control the operation of the FCD-E1 (front panel push buttons control is enabled).
Clock Polarity	JP10, JP11	The jumpers JP10 and JP11 are used to enable sampling of data on the rising edge or falling edge of the clock. The jumpers JP10 and JP11 control the clocks of Channel 1 and Channel 2, respectively.	**NORMAL –** Normal operation (data sampling on the rising clock edge). INVERT – Data sampling on the falling clock edge.

Table 2-1. Main Link Jumper and Switch Settings (Cont.)

Function	Jumper or Switch	Description	Values (Default value in bold)
Switch S1	Section 1 - **DEF PAR**	This section selects the source of the parameters for the supervisory ports.	**OFF –** The supervisory ports operate according to the user-defined parameters. ON **–** The FCD-E1 uses the default parameters, stored in its EPROM (9600 bps, 8 data bits, no parity, one stop bit, and terminal mode).
	Section 2 - **PASSW**	A password, consisting of up to eight alphanumeric characters, can be used to prevent unauthorized personnel from using the FCD-E1 supervision program. The FCD-E1 is delivered with a default password, **RAD**, but normally the user selects the password. Section 2 of S1 selects between the default FCD-E1 password (the ON position) and the user-selected password (the OFF position). The FCD-E1 polling address (node number) is also affected by section 2. With the jumper set at ON, the node number is set to 0. Upon first-time operation, you should use the ON position to start the configuration. You can select this position again to restart with the default password and node address 0 in case the current user password was lost.	ON – Default FCD-E1 password **OFF** – User-selected password
		Note *You can configure the supervisory port to operate without password protection. In this case, no password is used, irrespective of the position of the switch section.*	

Table 2-1. Main Link Jumper and Switch Settings (Cont.)

Function	Jumper or Switch	Description	Values (Default value in bold)
	Section 3 - **DB INIT**	This section selects the source of the data base configuration parameters.	**OFF –** On power-up, FCD-E1 loads the user-selected parameters from its non-volatile memory. ON – On power-up, FCD-E1 loads the default parameters stored in its program EPROM.
		Note *User-selected parameter values are not erased by setting one or more switch sections to ON: this action merely causes the FCD-E1 to use the default values. However, if the FCD-E1 is turned off and then powered up again, the default values replace the user values.*	
	Section 4 - **PC/SP**	This section is not used, and must always be set to **OFF.**	**OFF**
Note	*Jumpers JP2, JP68 and Interface changers RS-422/X.21, RS-422, X.21, and V.35 are permanently set at the factory. Do not move these jumpers from their factory positions!*		

Sublink Interface Board Settings

The jumpers and switches located on the FCD-E1 sublink interface board are identified in *Figure 2-5*. Their functions and settings are described in *Table 2-2*.

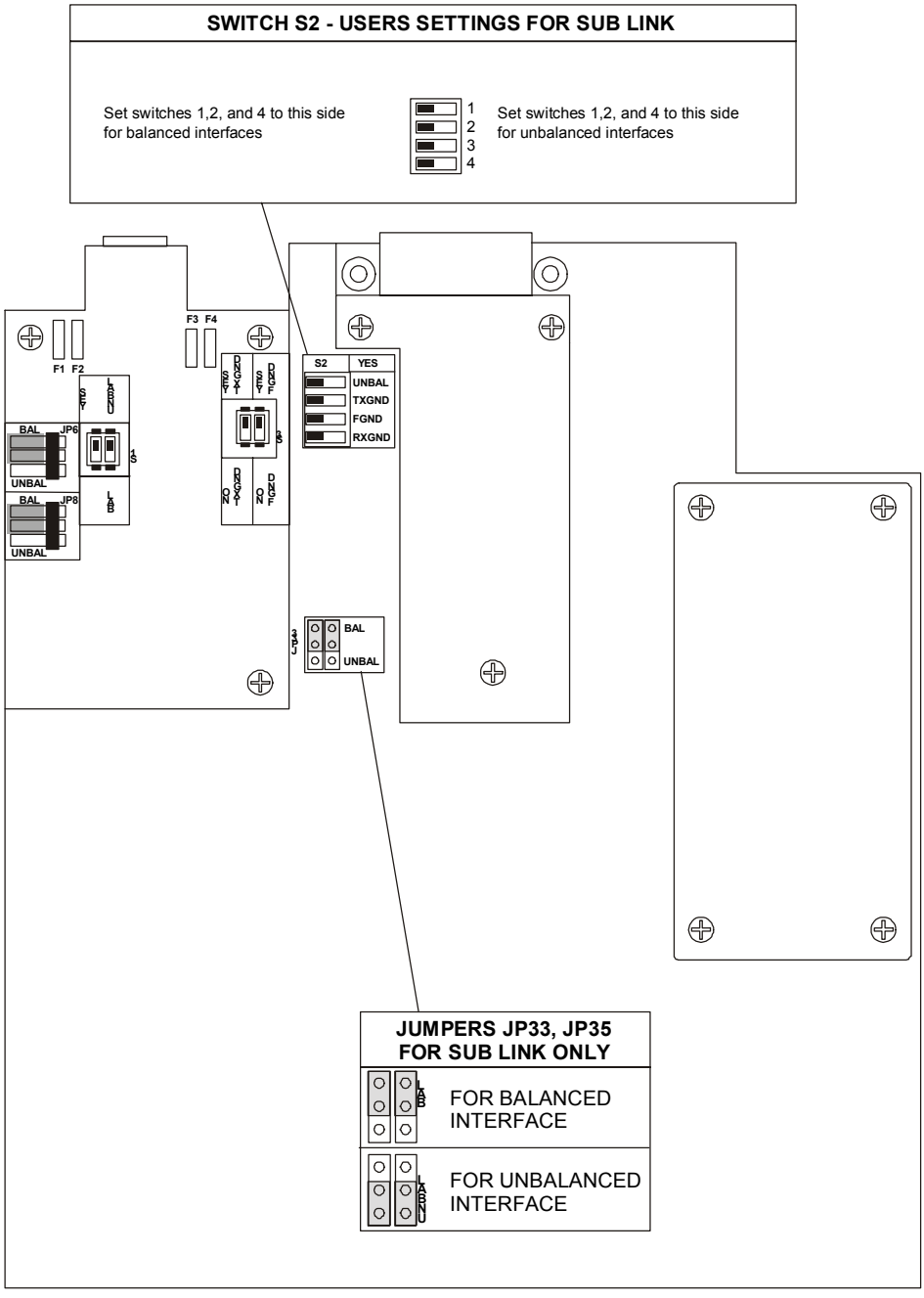


Figure 2-5. Sublink Interface Board, Internal Settings

Table 2-2. Sublink Jumper and Switch Settings

Function	Jumper or Switch	Description	Values (Default value in bold)
Sublink Interface Board Settings			
Sublink Interface Selection Jumpers	JP33, JP35, and S2 (1)	The jumpers JP33, JP35, and S2 (1), designated BAL/UNBAL, are used to select the sublink interface. All the jumpers must always be set to the same position.	**Balanced Interface –** Set jumpers JP33 and JP35 to BAL and set the switch S2 (1) to BAL. Unbalanced Interface – Set jumpers JP33, JP35 and switch S2(1) to UNBAL.
Sublink Transmit – Ground Reference Switch	TXGND S2 (2)	The TXGND switch is used to control ground reference of the sublink transmit output when the unbalanced interface is used. In accordance with ITU-T recommendations, the switch should be installed when the unbalanced interface is used.	**Switch not installed** (for Balanced Interface)
Sublink Receive – Ground Reference Switch	RXGND S2 (4)	The RXGND switch is used to control ground reference of the sublink receive input when the unbalanced interface is used. In accordance with ITU-T recommendations, this jumper should be set to YES when the unbalanced interface is used.	**NO** (for Balanced Interface)

Note

The interface board has protection fuses (F1 to F4) for the surge protection circuits located on the line side of the line isolation transformers. These fuses are also identified in Figure 2-8.

Reinstalling the FCD-E1 Cover

After completing the internal settings, reinstall the top cover.

➤ **To reinstall the FCD-E1 top cover:**

1. Position the lower half of the FCD-E1 case on a flat, clean surface.
2. Check that the decorative black plastic strips on the sides on the unit are still in place (if not, place the strips in the grooves on the sides of the lower half).

3. Identify the front and rear of the top cover, and position the cover on the lower half of the FCD-E1, so that the cover guides are located just above the holes in the lower half. Close the cover and ensure that the protruding tips of the cover guides enter the corresponding recesses in the lower half.
4. Hold the cover in place, and turn the assembly over, to gain access to the bottom of the unit.
5. Insert the original cover screws in their positions and tighten carefully. Do not use excessive torque.

2.6 Connecting the Cables

The connectors located on the rear panels of FCD-E1 depend on the equipment version (see the *FCD-E1 data sheet* for a complete list of ordering options).

Figure 2-6 shows a typical rear panel of an FCD-E1 unit with a single RS-530 interface data channel, and identifies connector locations.

Figure 2-7 shows a typical rear panel of an FCD-E1 unit with a sublink and 2 data channels. Note the additional connectors of the sublink.

Figure 2-8 shows a typical rear panel of an FCD-E1 unit with a sublink and an additional Ethernet port. The Ethernet interface has a shielded RJ-45 connector.

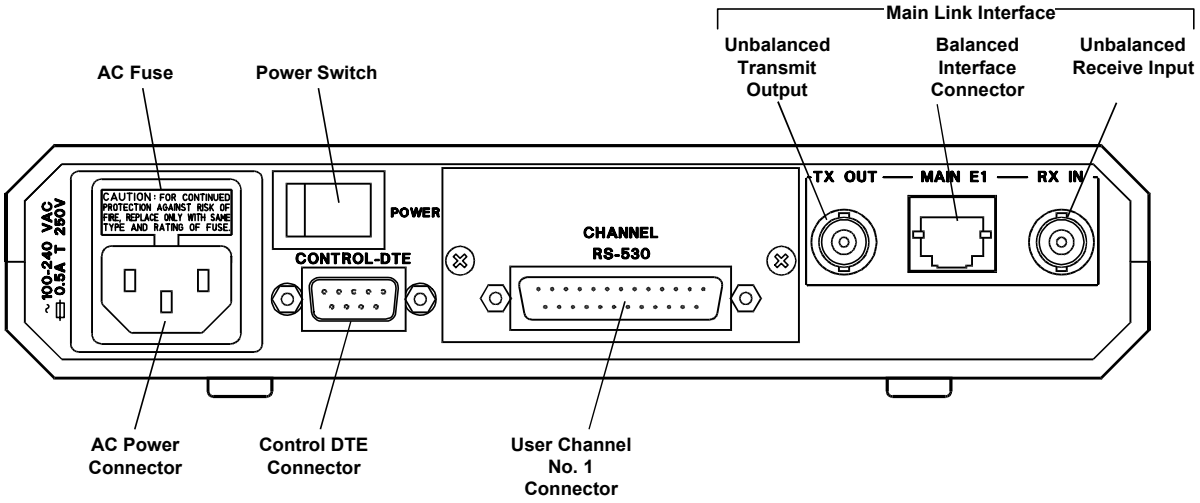


Figure 2-6. FCD-E1 with a Single Data Channel

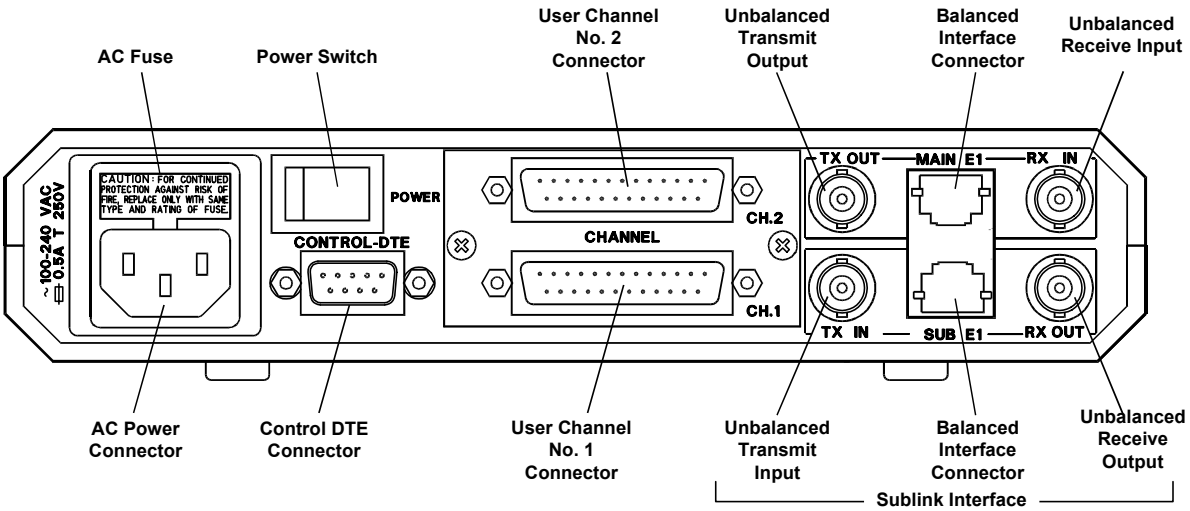


Figure 2-7. FCD-E1 with a Sublink and Two Data Channels

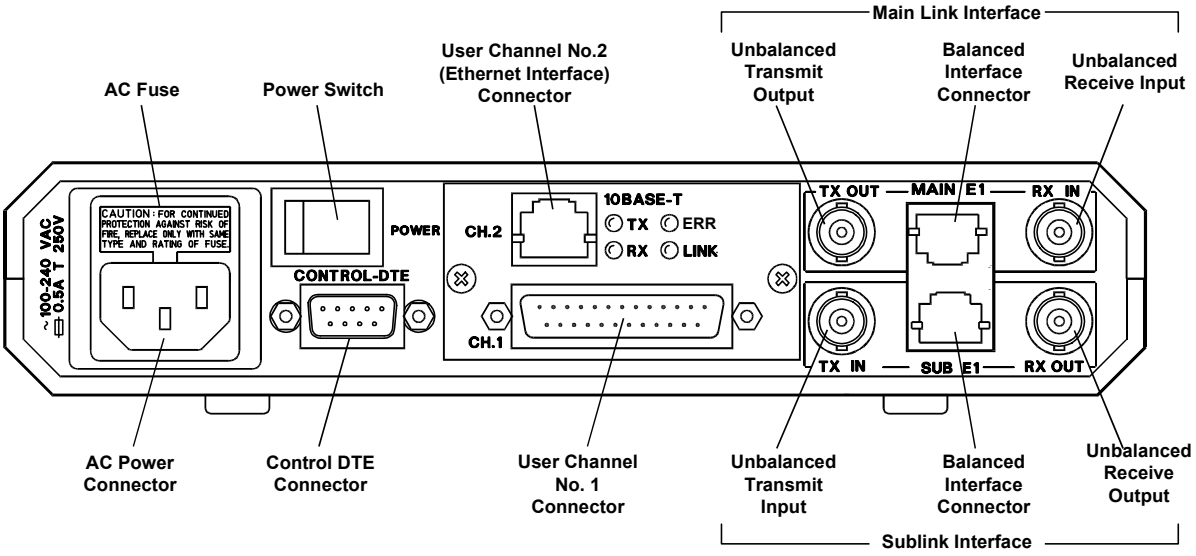


Figure 2-8. FCD-E1 with a Sublink and Additional Ethernet Port

The rear panels shown in *Figure 2-6*, *Figure 2-7* and *Figure 2-8* are for AC powered units. For DC-powered units, a circular three-pin DC power connector is used. In addition to the connectors located on the rear panel, the FCD-E1 has an additional supervisory port connector, located on the front panel.

Connecting the Electrical Main Link and Sublink

The main link port, in the electrical interface version, and the sublink port have two interfaces: a 120Ω balanced line interface, terminated in an RJ-45 eight-pin connector, and a 75Ω unbalanced interface, terminated in two BNC coaxial connectors.

Appendix A provides the pin allocation for the RJ-45 connector.

➤ **To connect the main link and the sublink:**

- Connect the main link and, when applicable, sublink cables to the connectors corresponding to the interfaces in use.

Warning

Do not connect to both the balanced and unbalanced interfaces of the same link!

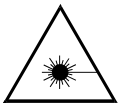
- When using the balanced interfaces, connect the cable to the RJ-45 connectors designated MAIN E1 and/or SUB E1, respectively.
- When using the unbalanced interface, connect the cable to the two BNC connectors of the appropriate interface:
  - The BNC connectors of the main link interface are designated TX OUT (transmit output) and RX IN (receive input).
  - The BNC connectors of the sublink interface are designated RX OUT (receive output) and TX IN (transmit input).

Pay attention to correct connection of the transmit and receive cables to the TX and RX connectors of each interface.

Note

The various user interface cables should be shielded, to improve EMC. FCD-E1A and its interfaces will work well even if the cables are not shielded, but some radio interference may occur.

Connecting the Fiber Optic Link



Laser Warning

FCD-E1 units with fiber-optic main link interface may include Class 1 lasers.
For your safety:
Do not look directly into the optical connectors or the cable itself while the FCD-E1 is operating.
The use of optical instruments with this product will increase eye hazard. Laser power up to 1 mW at 1310 nm and 1550 nm could be collected by an optical instrument.

The fiber optic E1 link interface is terminated in two ST or FC/PC connectors, in accordance with order. The maximum allowable attenuation depends on the interface option (refer to the *Table 1-2*).

Before connecting, clean the optical connectors using an approved solvent and dry thoroughly using optical tissue.

➤ **To connect the fiber optic link:**

1. Connect the optical connector designated TX to the transmit port of the local FCD-E1 unit (transmit output connected to the receive input of the remote unit).
2. Connect the optical connector designated RX to the receive port of the local FCD-E1 unit (receive input, coming from the transmit output of the remote unit).

Avoid sharp bends and twisting of the fiber optic cables.

Connecting the Synchronous Data Channel

The data channel of FCD-E1 is terminated in a 25-pin D-type female connector. The interface type is RS-530, V.35, V.36/RS-449, or X.21, according to order.

- When using the RS-530 interface, equipment with RS-530 interface can be directly connected to the data channel connector using standard cables.
- When the interface type is V.35, the adapter cable is terminated in a 34-pin female connector.
- When the interface type is V.36/RS-449, the adapter cable is terminated in a 37-pin D-type female connector.
- When the interface type is X.21, the adapter cable is terminated in a 15-pin D-type female connector.

When using adapter cables, first connect the adapter cable to the channel connector, and then connect the user's data cable to the adapter connector.

The cables for DCE clock mode are supplied in accordance with order. Cables for DTE1 and DTE2 clock modes can be prepared in accordance with the port connector wiring information given in *Appendix A* or ordered separately from RAD. The use of each cable is listed in *Table 2-3*. *Appendix A* provides pin allocations and cable wiring data.

Table 2-3. FCD-E1 Interface Adapter Cables

Cable	User Interface	Clock Mode	Length (m / ft)
CBL-HS2/V/1	V.35	DCE	2 / 6
CBL-HS2/V/2	V.35	DTE1	2 / 6
CBL-HS2/V/3	V.35	DTE2	2 / 6
CBL-HS2/R/1	V.36/RS-449	DCE	2 / 6
CBL-HS2/R/2	V.36/RS-449	DTE1	2 / 6
CBL-HS2/R/3	V.36/RS-449	DTE2	2 / 6
CBL-HS2/X/1	X.21	DCE	2 / 6

Ethernet Data Channel

The Ethernet channel interface supports connection to LANs operating on UTP media.

The Ethernet bridge or router interface has a shielded RJ-45 connector for connection by means of a straight cable to 10BaseT hub ports.

Appendix A provides the pin allocations.

If you need to connect the Ethernet interface directly to another equipment unit (e.g., to a PC with Ethernet NIC) without passing through an Ethernet hub, use a cross-cable.

Connecting the Management Ports

This section provides information on the management connections.

FCD-E1 has one supervisory port, CONTROL DCE, located on the front panel, and a dial-out port for connection to modems, CONTROL DTE, located on the rear panel.

Connecting the CONTROL DCE Port

The front panel CONTROL DCE supervisory port has a 9-pin D-type female connector with RS-232 interface. The interface (DCE or DTE) is software selectable. The default selection, DCE, enables direct connection to terminals and management stations; when the supervision terminal or management station is connected via modems, LAN extenders, or similar equipment with DCE interfaces (the interface is configured as DTE), it is necessary to use a crossed adapter cable.

Appendix A provides the pin allocation for the connector.

Connecting the CONTROL DTE Port

This connector is intended for connection to a modem or low-speed multiplexer link, for communicating with remotely located supervisory terminals, management stations, etc. Use a straight cable to connect to a modem. You may also use a dial-up modem, configured for auto-answer and preprogrammed to dial the desired number, to automatically report alarms to a central location.

Appendix A provides the pin allocation for the connector.

Connecting the Alarm Relay

When the alarm relay is in use (Jumpers JP51 and JP52 set to RELAY), its contacts are available in the CONTROL DTE connector, and you can connect them as described in *Appendix A* to automatically turn on a bay alarm indication. The use of the alarm relay does not prevent the connection of a modem to the CONTROL DTE connector.

Connecting the Power

To connect the power to FCD-E1, refer to the appropriate section below, depending on your version of the unit (AC or DC).

Warning

Before connecting any other cables and before switching on this instrument, this instrument must be connected to the protective ground. The connection is made through the protective ground conductor of power cord. The power plug shall only be inserted in a power outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).
Make sure that only fuses with the required rated current, as marked on the FCD-E1 rear panel, are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders are forbidden.
Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

AC Power Connection

AC power should be supplied to FCD-E1 through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug. The power cable is provided with the unit.

➤ **To connect AC power to FCD-E1:**

1. Check that the POWER switch on the FCD-E1 rear panel is set to OFF.
2. Connect the power cable to the power connector on the FCD-E1 rear panel.
3. Connect the power cable to the mains outlet.

DC Power Connection

➤ **To connect DC power to FCD-E1:**

- Refer to the *DC Power Connection Supplement*.

Chapter 3
Operation

3.1 Turning FCD-E1 On

To turn FCD-E1 on, set the rear POWER switch to ON (AC version) or connect it to the power supply (DC version). Upon turn-on, FCD-E1 performs self-test: observe the front-panel indications.

During the self-test, FCD-E1 displays the software version in the format X.YZ:

```
FCD                    REV X.YZ
         SELF TEST
```

After successfully completing the self-test procedure, FCD-E1 switches to the default ALARM BUFFER screen. If FCD-E1 fails the self-test, you will see SELF TEST FAILED in the second row. In this case, FCD-E1 must be repaired before it can be used again.

Warning

Access to the inside of the unit is permitted only to qualified and authorized personnel.

3.2 Controls and Indicators

Table 3-1 lists the functions of the FCD-E1 controls, connectors and indicators, located on the FCD-E1 front panel. The index numbers in *Table 3-1* correspond to the item numbers in *Figure 3-1*.

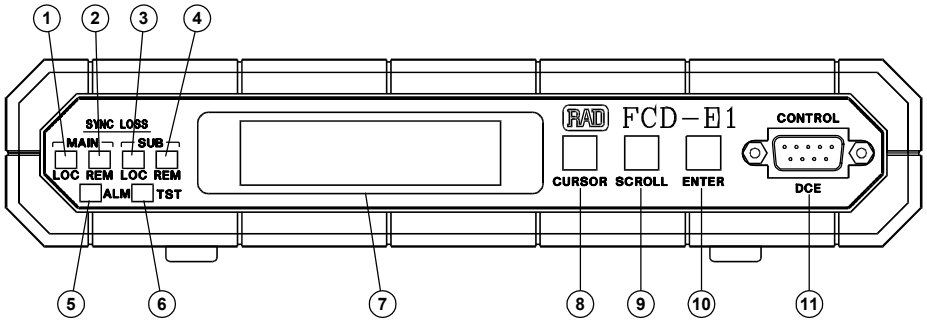


Figure 3-1. FCD-E1 Front Panel

Table 3-1. Controls, Connectors and Indicators

No.	Control or Indicator	Function
1	MAIN LOC indicator	Lights to indicate local loss of synchronization on the main link
2	MAIN REM indicator	Lights to indicate remote loss of synchronization on the main link
3	SUB LOC indicator	Lights to indicate local loss of synchronization alarm on the sublink
4	SUB REM indicator	Lights to indicate remote loss of synchronization on the sublink
5	ALM indicator	Lights to indicate that an alarm condition is present in the system
6	TST indicator	Lights when a test is active
7	Alphanumeric display	Liquid crystal display (LCD) used to display messages and status information. The display contains 2 rows of 16 characters each
8	CURSOR push button	Used to move among the display fields
9	SCROLL push button	Used to scroll among the available options of the displayed functions
10	ENTER push button	Used to enter the changes made in the FCD-E1 operation, and initiate operation in the new set-up
11	CONTROL DCE connector	Used to connect to a supervision terminal or management station

Organization of LCD

The FCD-E1 display has two rows:

- **Upper row.** Shows the name of the displayed function, group of configuration parameters, or test option.
- **Lower row**. The lower row displays:
  - Parameter name and value
  - Status messages
  - Loopback status
  - Error messages
  - Diagnostics messages.

The front panel menu structure is shown in *Figure 3-2*.

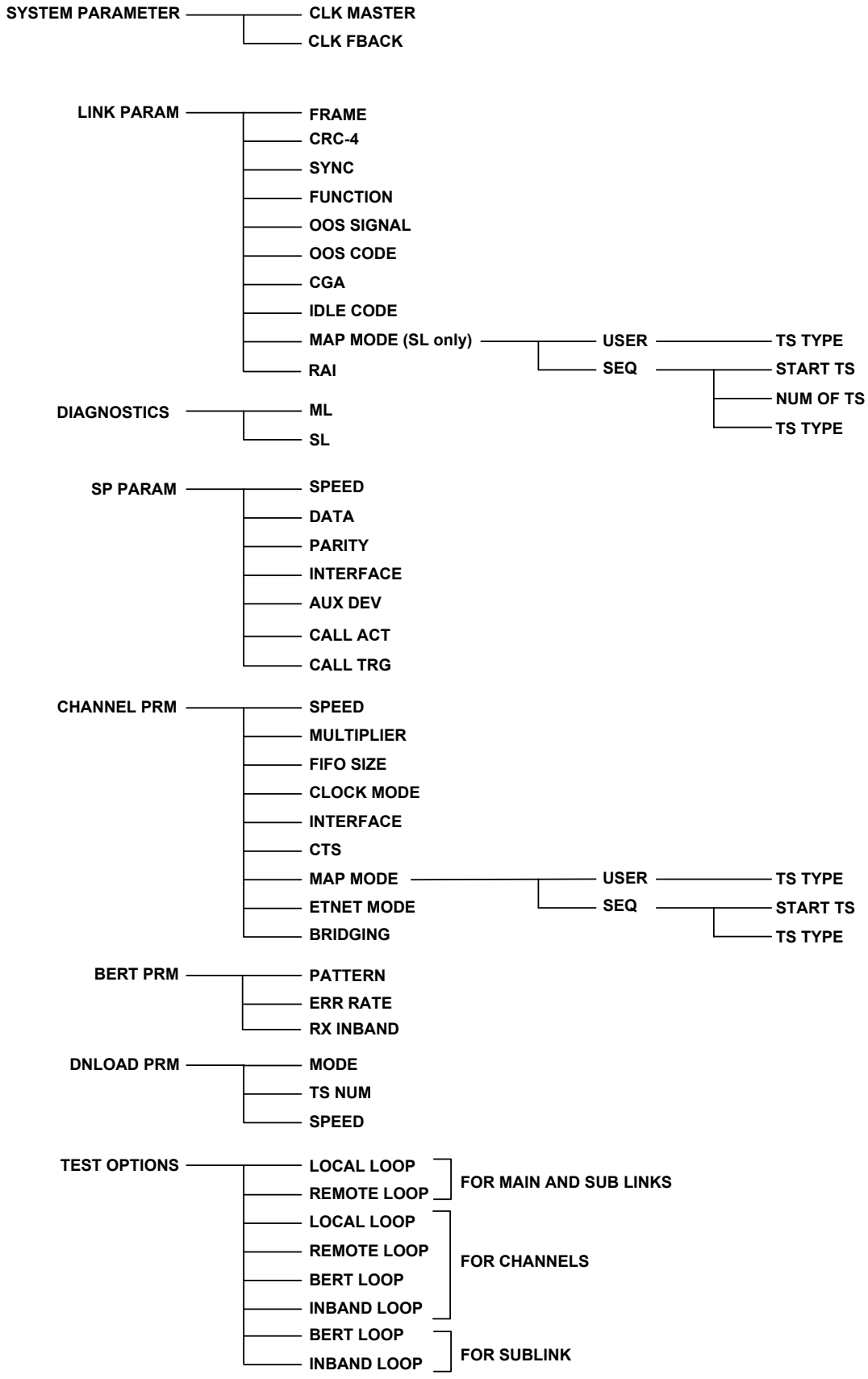


Figure 3-2. FCD-E1 Front Panel Menu Structure

Information Displayed on the LCD

The FCD-E1 alphanumeric display has four main functions:

- Display of status messages
- Display of diagnostics performance data
- Display of test functions
- Display of configuration parameters.

Status Messages

When the FCD-E1 is not being configured, its display shows status messages. The status messages appear under the header ALARM BUFFER. The status messages are described in *Chapter 5*.

Diagnostics Functions

The diagnostic data displayed by the FCD-E1 are explained in *Chapter 5*. The diagnostic data appears under the header DIAGNOSTICS.

Test Functions

The test functions include:

- Basic test loopbacks, for rapid isolation of faults.
- Bit error rate testing on each data channel.

The test function messages appear under the header TEST OPTIONS. *Chapter 5* describes the available test functions.

Using the Front Panel Push Buttons

The FCD-E1 front panel contains three push buttons designated CURSOR, SCROLL and ENTER. These buttons control the LCD display and let you view and change FCD-E1 parameters.

CURSOR Moves the cursor among the fields in the current display.

SCROLL Changes the selected item. Press SCROLL to display the alternatives in the selected field. Hold SCROLL down to scroll through the options automatically.

ENTER Press ENTER to choose the selected parameter value.

- If the new value is valid, it replaces the old value and the change takes effect immediately.
- If the new value is not valid, it is not accepted and FCD-E1 displays a CONFIG ERROR message with a two-digit code in the second display row. After a short time, the error message disappears and FCD-E1 returns to the original display. Refer to *Chapter 5* for a list of error codes and how to correct the errors.

Additional Function of Enter

When the alarm buffer is displayed, the ENTER push button can be used to erase the currently displayed alarm message, and to reset the OOS, BPV, or CRC error counters.

If you make an incorrect selection, the selection is not accepted. In this case, you see a **CONFIG ERROR** message with a two-digit code in the second display row. The code indicates what is wrong. *Configuration Error Messages* on page *6-3* explains the codes and what to do to correct the error.

After a short time, the error message disappears and you see again the original display. Now you can correct the error.

Normal Indications

LCD

The normal message displayed in the top row is ALARM BUFFER. If no alarm is stored in the alarm buffer, FCD-E1 continues to display the last user-selected display.

In addition, FCD-E1 automatically aborts the current activity and redisplays the ALARM BUFFER message if no front-panel button is pressed for one minute and the alarm buffer is not empty. This ensures that it will not remain in an indeterminate state even if the operator does not complete a configuration activity.

When the top row shows ALARM BUFFER, the second row displays the following information:

- During normal operation, the second row should show EMPTY (no alarm messages).
- If the alarm buffer contains alarms, you will see SCROLL in the left-hand field of the second row, and CLEAR in the right-hand field.

LEDs

During normal operation, the ALM, SYNC LOSS, and TST indicators must be off.

Fault Indications

Any alarm condition causes the ALM indicator to light. Use the supervision terminal to read the alarm messages.

If any of the main link alarm indicators or the TST indicator lights, data transfer is interrupted.

If any of the sublink alarm indicator lights, data transfer is interrupted only for the sublink.

- The TST indicator lights when a test is activated. If the test is activated from the local FCD-E1A, see the test type using the supervision terminal. You can disconnect a local loop as explained in *Chapter 4* or *Appendix D*.
- A LOC indicator lights when a local loss of synchronization condition is present on the corresponding link.
- A REM indicator lights when a remote loss of synchronization condition is present on the corresponding link.

Ethernet Interface Indications

For information concerning the IR-ETH and IR-ETH/Q interface indicators, refer to *Appendix E* and *Appendix F,* respectively

3.3 Default Settings

If the configuration data stored by FCD-E1 is corrupted, the DB CHKSUM ERR alarm message is generated. In this case, you will have to load the default configuration.

➤ **To load the default configuration:**

1. Turn FCD-E1 off.
2. Set section 3 of the internal switch S1 to ON.
3. Turn FCD-E1 on.
4. Turn FCD-E1 off.
5. Set section 3 of the internal switch S1 to OFF.

You can verify the FCD-E1 configuration as explained below. If the configuration does not require modification, the FCD-E1 is ready for operation immediately after self-test is completed. To change the configuration, refer to the *Local Configuration Setup Procedure* below.

Checking Current Operating Configuration

This section provides instructions for displaying the current configuration parameters (diagnostic and test functions are not included). The instructions are presented in a step-by-step format that will help you familiarize with the use of front panel push buttons. You may also refer to the menu structure shown in *Figure 3-2* for navigation.

Note

During the following procedure, do not press the ENTER push button, to prevent accidental change of parameters.

1. Bring the cursor under the leftmost field in the top row (if not already there)
2. Scroll to display SYSTEM PARAMETER in the top row

   Second row shows the first system parameter, CLK MASTER, and its current selection
3. Bring the cursor under the left-hand field in the second row.
4. Scroll to see the other system parameters.

   After each time SCROLL is pressed the second display row shows the current value of the next system parameter. Continue until CLK MASTER appears again.
5. Bring the CURSOR under the leftmost field in the top row.
6. Scroll to display the next group of configuration parameters, LINK PARAM.

7. Bring the cursor under the rightmost field in the top row, and scroll to display ML (main link).

   The second row shows the first main link parameter, FRAME, and its current value.

8. Repeat steps 3, 4 to see the other main link parameters.

   After each time SCROLL is pressed, the second row shows the current value of the next main link parameter. Continue until FRAME appears again.

9. For FCD-E1 versions with a sublink, bring the cursor under the rightmost field in the top row, and scroll to display SL (sublink).

   The second row shows the first sublink parameter, FRAME, and its current value.

10. Repeat steps 3, 4 to see the other sublink parameters.

    After each SCROLL pressing, the second row shows the current value of the next sublink parameter. Continue until FRAME appears again.

Note

When displaying the sublink timeslot assignment in the USER mapping mode, the second row includes a timeslot number field (in the middle of the row). To display the selections made for each timeslot, move the cursor under this field and scroll.

11. Repeat steps 1 through 4 to display the supervisory port parameters, SP PARAM.
12. Repeat steps 5 through 8 to display the channel 1 parameters, CHANNEL PRM CH1.
13. For the FCD-E1 versions with two data ports, or with an Ethernet interface, repeat steps 6, 7, 8 to display the parameters for channel 2 (serial or Ethernet interface), CHANNEL PRM CH2.
14. Repeat steps 1 through 4 to display the download parameters, DNLOAD PRM.

3.4 Configuration Alternatives

This section presents information regarding the connection of a management facility (supervision or alarm monitoring terminal, Telnet host, SNMP network management station, etc.) to an FCD-E1 system.

In addition to the information presented in this section, FCD-E1 also supports management by a remote facility. The facility can be connected to another RAD equipment unit (e.g., MEGAPLEX and MAXcess multiplexers, DXC multiservice access nodes, FCD-E1 and FCD-T1 fractional E1, respectively T1, integrating multiplexers, etc.) that is connected to one of the FCD-E1 links (this management method is called *inband management*). Specific information regarding inband management is presented in the *SNMP Management* appendix.

Connecting Supervision Terminals

Supervision terminals are supported through the front-panel CONTROL DCE port. CONTROL DCE ports are located on all the FCD-E1 versions, and have standard RS-232 asynchronous interfaces.

The supervision terminals can be connected either directly to the FCD-E1 system CONTROL DCE port, or through a modem link (for convenience, the term *modem link* is also used to represent any other type of full-duplex data link).

CONTROL DCE Port Interface Characteristics

The CONTROL DCE port supports the following data rates: 300, 1200, 2400, 4800, 9600 or 19200 bps. The word format consists of one start bit, 7 or 8 data bits, and one stop bit. Parity can be odd, even or disabled. Always make sure the communication interfaces of the equipment (terminal, modem, etc.) connected to the CONTROL DCE port and the port itself are configured for operation with the same parameters.

To simplify the establishment of communication, the CONTROL DCE port supports the AUTOBAUD function. When this function is enabled, the FCD-E1 system can identify the data rate of the signal received at the CONTROL DCE port by analyzing the timing of three consecutive Carriage Return + Line Feed characters (generated by pressing three times the <**Enter**> key). The detected data rate is then used for the current communication session.

Direct Connection to CONTROL DCE Port

The CONTROL DCE port enables direct connection to terminals. Usually, terminals have DTE interfaces, therefore in this case the connection of the terminal to the CONTROL DCE port is made by means of a straight cable (a cable wired point-to-point).

Connection to CONTROL DCE Port through a Modem Link

The CONTROL DCE port also supports the connection of a remote supervision terminal through a modem link.

Note *The CONTROL DCE port supports only dial-in, that is, it cannot dial out.*

For connection to a modem, you need a cross cable (also called null modem cable). *Appendix A* presents wiring information for various types of cables.

Two types of modems are supported:

- Dial-up Hayes™ compatible modems, e.g., the RAD miniature DLM/AT modem.
- Multidrop modems, e.g., the RAD SRM-6 miniature multidrop modem. Multidrop connections are explained in the following section.

Multidrop Connections

You may use a multidrop configuration to connect the supervisory ports of several FCD-E1 system units to a common supervision terminal using multidrop modems or digital sharing devices.

For multidrop operation, each FCD-E1 system must be assigned a node address in the range of 1 through 255.

Note

FCD-E1 systems also support address 0: assigning address 0 to a FCD-E1 system means that it will accept and answer any message: this is not permitted in multidrop operation. Address 0 is however recommended for use both with direct connections, and point-to-point or dial-up modem links.

In addition, each FCD-E1 can be assigned a logical name of up to eight characters. The logical name is sent in each transmission of alarm messages. The name helps the operator to identify the source of messages that are received by the supervision terminal.

Connecting Alarm Monitoring Terminals

FCD-E1 systems support automatic reporting of alarms to remote terminals. This function is supported through the rear panel CONTROL DTE port (the CONTROL DTE port does not support supervision terminals).

Generally, the alarm-monitoring terminal is connected to the CONTROL DTE port of an FCD-E1 system through a dial-up modem link.

CONTROL DTE ports are located only on all FCD-E1 versions. The CONTROL DTE port has a standard RS-232 asynchronous interface.

CONTROL Port Interface Characteristics

The CONTROL DTE port supports the following data rates: 300, 1200, 2400, 4800, 9600 or 19200 bps. The CONTROL DTE port does not support the AUTOBAUD function.

Note

The data rate used by the CONTROL DTE port is always equal to the data rate configured by the user. It need not be equal to the data rate used at the CONTROL DCE port.

The word format consists of one start bit, 7 or 8 data bits, and one stop bit. Parity can be odd, even or disabled. Always make sure the communication interfaces of the equipment (e.g., dial-up modems, etc.) connected to the CONTROL DTE port and the port itself are configured for operation with the same parameters.

Connection of Dial-Up Modem

If you are using a dial-up modem, connect a straight cable from the modem to the CONTROL DTE connector of the FCD-E1.

Connecting Telnet Hosts

The Telnet protocol enables communication with multiple FCD-E1 system units, using either inband or out-of-band communication:

- For communicating out-of-band, the Telnet host must be connected to the to the serial port of the FCD-E1 system.
- For inband communication, the user can enable the transfer of management traffic through the main and/or sublinks.

The Telnet protocol operates over IP. Since the IP traffic is automatically routed to the desired unit through the internal IP routers of chained equipment (see the *SNMP Management* appendix), the connection of a Telnet host to one FCD-E1 unit may provide management access to many interconnected FCD-E1 units. This connection can also provide management access to other types of equipment that support this type of management (for example RAD's MEGAPLEX and MAXcess multiplexers, DXC multiservice access nodes, FCD-E1 and FCD-T1 fractional E1, respectively T1, integrating multiplexers, etc.).

Connection to Serial Ports (Out-of-Band Communication)

Telnet hosts can connect to a serial FCD-E1 port: either to the CONTROL DCE port or to the CONTROL DTE port, available on all FCD-E1 units.

- The connection to the CONTROL DCE port is made as explained in the *Connecting Supervision Terminals* on page *3-8*. Both direct connection, and connection through a modem link, are possible. The use of multidrop configurations is not recommended.

  When connecting to the CONTROL DCE port, make sure to disable the AUTOBAUD function, otherwise communication using the SLIP protocol is not possible.
- The connection to the CONTROL DTE port is made as explained above in the *Connecting Alarm Monitoring Terminals* on page *3-9*.

  To enable using the appropriate protocol (SLIP or PPP) at the CONTROL port, make sure to configure the CONTROL port interface as DCE (this is performed by internal switches).

Connecting SNMP Management

The SNMP protocol also operates over IP, therefore all the requirements described above for Telnet management also apply to the connection of SNMP network management stations.

Multidrop configurations must not be used with SNMP, because multidrop operation requires that all the units strictly observe the rules of polled communication. This is not true for SNMP agents, because they can initiate transmissions on their own (whenever they have a trap to transmit).

3.5 Local Configuration Setup Procedure

Before starting any configuration action:

- Review relevant configuration parameters listed in *Appendix D*.
- Review a list of the required parameters from your network subscription data and/or from your system administrator.
- Make sure that all the user-initiated loopbacks are disconnected. To disconnect the loopbacks, select OFF in the TEST OPTION field (refer to *Chapter 5*).

➤ **To set up the FCD-E1 configuration:**

1. Select the system parameters.
2. Select the main link parameters.
3. Select the sublink parameters.
4. Select the channel parameters.
5. Select the supervisory port parameters (if FCD-E1 is going to be controlled via a terminal).
6. Select the download parameters (to enable inband management).

FCD-E1 presents only those parameters available in the selected mode; therefore it is important to perform the configuration according to the order specified above.

Note

Before starting the configuration procedure, always disconnect all the user-initiated loopbacks (select OFF on TEST OPTIONS). If you try to configure while a user-initiated loopback is active, the CONFIG ERROR 008 message is displayed. Refer to Configuration Error Messages on page 6-3 for an explanation of the configuration error messages the FCD-E1 displays when you make an error.

➤ **To configure the FCD-E1 unit:**

1. Bring the cursor under the leftmost field in the top row (if not already there).
2. Scroll to display the desired group of parameters in the top row; the second row shows the first parameter in the selected group and its current value.

Note

When the desired group of parameters must be separately selected for each link and/or data channel, the top row includes an additional field (at the rightmost side of the top row): this field is used to select the link type (main or sub), respectively the channel number. In this case, use the CURSOR key to bring the cursor to the link or channel field, then SCROLL to show the desired link or channel.

3. Bring the cursor under the leftmost field (parameter name) in the second row.
4. Scroll to display the desired parameter in the selected group. For certain parameters, for example timeslots, an additional field located in the left-hand field of the second row is used to select an individual item; the second row shows the parameter name and its current value.
5. Bring the cursor to the right-hand field (parameter name) in the second row.
6. Scroll to set the required value for the displayed parameter; the right-hand field in the second row shows the available values.
7. When the desired parameter value is displayed, select the new parameter value by pressing ENTER; the cursor remains on the right-hand field of the second row. The second row displays shortly CONFIG ENTER, then returns to the normal display.

Note

You must press ENTER after changing parameters of a certain group, such as SYSTEM, CH1, etc. If you change parameter values, but return the cursor to the first field of the first row and scroll to another group without pressing ENTER, the changes are discarded and you will see the message CONFIG LOST.

8. Repeat steps 3 through 6 until values are assigned to all the parameters in the group; the second row shows the current selection.
9. Repeat steps 1 through 8 until values are assigned to all the parameters in the desired groups; the second row shows the current selection.
10. After completing the configuration actions, you can use steps 1 and 2 to return to the ALARM BUFFER; the top row shows: ALARM BUFFER.

If alarm messages are stored in the alarm buffer, ALARM BUFFER will be automatically displayed if no pushbutton is pressed for one minute.

3.6 Turning FCD-E1 Off

➤ **To turn FCD-E1 off:**

- If you have an AC version, set the FCD-E1 rear power switch to OFF.
- If you have a DC version, disconnect the power cord from the unit.

Chapter 4
Configuration

This chapter provides detailed instructions for managing FCD-E1 by means of ASCII terminals and Telnet. The information presented in this chapter includes:

- Configuration sequence
- Introduction to configuration and management activities
- Checking current operating configuration
- Preliminary configuration
- Connection methods for terminals and Telnet hosts
- Concise description of the set of commands available for the supervision terminal (the same set is available to Telnet users).
- Using the explicit command mode
- Supervision terminal operating instructions

The instructions appearing in this chapter assume that the supervision terminal operator is familiar with the FCD-E1 system and its configuration parameters.

4.1 Configuration Sequence

To prepare a typical FCD-E1 system for operation in accordance with customer's requirements, perform the following activities in the order given in *Table 4-1*.

Table 4-1. Outline of Configuration Procedures

Step	Activity	Reference
1	Perform the preliminary configuration	*Section 4.3*
2	Define system configuration	DEF SYS
3	Configure each port and its connections	DEF ML DEF SL DEF CH1, DEF CH2
4	Define the general system parameters	DEF NAME DEF PWD
5	Define network port configuration and dial-up parameters (when applicable)	DEF CALL
6	Define alarm handling parameters	DEF ALM MASK

4.2 Introduction

FCD-E1 operating mode is determined by a set of parameters stored in an internal non-volatile memory. You select these parameters, using the FCD-E1 front panel push buttons, a supervision terminal, or a network management station (either a generic SNMP management station, or the RADview management station offered by RAD). When a supervision terminal, or a network management station is in control, the FCD-E1 cannot be controlled from the front panel; however, when under the control of a network management station, the front panel can still be used to read the current parameters, status, and statistics.

The FCD-E1 has six groups of configuration parameters:

- System parameters
- Main link parameters
- Sublink parameters
- Channel parameters
- Supervisory port parameters
- Download parameters.

In addition to the parameters configured from the front panel, there are parameters that can be controlled only from a supervision terminal or remote management station. These are presented in *Appendix D*.

After configuration, if alarm messages are stored in its ALARM BUFFER, the FCD-E1 automatically returns to the display of status messages.

After the operating parameters have been selected, a process called configuration set-up is performed and the FCD-E1 no longer requires operator attendance. The configuration stored in the FCD-E1 memory is not affected when power is turned off.

Upon turn-on, the FCD-E1 checks the validity of the stored configuration data, and if everything is OK, it assumes the last selected configuration.

- If the configuration does not require modification, the FCD-E1 is then ready for operation immediately after power is applied.
- If the configuration data is not valid, the FCD-E1 lets you load instead a default configuration. The default configuration, prepared by the manufacturer, is stored in the program EPROM.

Configuration and Management Activities

Before an FCD-E1 system can be used in its intended application, it is necessary to perform two types of activities:

- **Preliminary configuration**, which prepares the FCD-E1 system for using any of the management facilities supported by the system.

  The preliminary configuration of the FCD-E1 system must always be performed using an ASCII terminal equipped with an RS-232 communication interface, directly connected to the FCD-E1 supervisory port (the CONTROL DCE connector).

The ASCII terminal can be a standard “dumb” communication terminal or a personal computer running a communication program that emulates an ASCII terminal.

- **System configuration** used to specify the system operational parameters needed by the FCD-E1 system to fulfill its intended function in the user’s environment.

  After performing the preliminary configuration, you can configure the FCD-E1 system using any of the following options:

  - Use the terminal as a supervision terminal, for performing all the management activities supported by the FCD-E1 system. The software necessary to run the FCD-E1 system supervision program is contained in FCD-E1. Moreover, FCD-E1 stores all the configuration information generated or altered during the communication with the terminal. No information is stored in the terminal.
  - Configure the FCD-E1 system from any IP host using the Telnet protocol. After establishing a Telnet session with the FCD-E1 system, the Telnet protocol offers the same functionality as the supervision terminal, and in addition enables remote access over IP networks.

    Typically, the Telnet host is a PC or a UNIX station with the appropriate suite of TCP/IP protocols. The host can be directly connected to the managed FCD-E1 system unit using the FCD-E1 serial communication ports. However, the host may also be located at a remote site, the only requirement being that IP communication be established between that site and the managed FCD-E1 system (either out-of-band, through a separate network, or through inband channels).
  - Configure the FCD-E1 system by means of SNMP-based network management stations.

The *Configuration Sequence* on page *4-1* provides an outline of the FCD-E1 system configuration activities.

During regular operation, the FCD-E1 system can be managed using any of the options listed above for system configuration.

Checking Current Operating Configuration

This section provides instructions for displaying the current configuration parameters (diagnostic and test functions are not included). The instructions are presented in a step-by-step format that will help you familiarize with the use of front panel push buttons. You may also refer to the menu structure shown in *Using the Mnemonic Mode* on page *4-18* for navigation.

Note *During the following procedure, do not press the ENTER push button, to prevent accidental change of parameters.*

1. Bring the cursor under the leftmost field in the top row (if not already there)
2. Scroll to display SYSTEM PARAMETER in the top row

   Second row shows the first system parameter, CLK MASTER, and its current selection
3. Bring the cursor under the left-hand field in the second row.
4. Scroll to see the other system parameters.

   After each time SCROLL is pressed the second display row shows the current value of the next system parameter. Continue until CLK MASTER appears again.
5. Bring the CURSOR under the leftmost field in the top row.
6. Scroll to display the next group of configuration parameters, LINK PARAM.
7. Bring the cursor under the rightmost field in the top row, and scroll to display ML (main link).

   The second row shows the first main link parameter, FRAME, and its current value.
8. Repeat steps 3, 4 to see the other main link parameters.

   After each time SCROLL is pressed, the second row shows the current value of the next main link parameter. Continue until FRAME appears again.
9. For FCD-E1 versions with a sublink, bring the cursor under the rightmost field in the top row, and scroll to display SL (sublink).

   The second row shows the first sublink parameter, FRAME, and its current value.
10. Repeat steps 3, 4 to see the other sublink parameters.

    After each SCROLL pressing, the second row shows the current value of the next sublink parameter. Continue until FRAME appears again.

Note *When displaying the sublink timeslot assignment in the USER mapping mode, the second row includes a timeslot number field (in the middle of the row). To display the selections made for each timeslot, move the cursor under this field and scroll.*

11. Repeat steps 1 through 4 to display the supervisory port parameters, SP PARAM.
12. Repeat steps 5 through 8 to display the channel 1 parameters, CHANNEL PRM CH1.
13. For the FCD-E1 versions with two data ports, or with an Ethernet interface, repeat steps 6, 7, 8 to display the parameters for channel 2 (serial or Ethernet interface), CHANNEL PRM CH2.

Repeat steps 1 through 4 to display the download parameters, DNLOAD PRM.

4.3 Preliminary Configuration

The scope of the preliminary configuration activities is to enable management communication with FCD-E1.

Preparation of FCD-E1

See *Chapter 2* for detailed information on internal settings, and connection instructions.

Selection of Default Password

Generally you must enter a password when you start a control session. If the password is incorrect, FCD-E1 will not respond. This can be corrected by appropriate setting of the PASSW section of DIP switch S1, located on the FCD-E1 main board.

Note *FCD-E1 is affected by the DIP switch setting only if the 'password' parameter in DEF SP is set to 'yes'.*

Set the PASSW section of DIP switch S1 as follows:

- **OFF** – In this position, you can define your own password and node address.
- **ON** – Set the section to ON to restore the default case-sensitive FCD-E1 password (**RAD**), and change the node address to the default value of 0. The change will be made after you turn the FCD-E1 off for a short time, and then back on.

Selection of Default Supervisory Port Parameters

If the supervisory port parameters are not correct, FCD-E1 will not respond. This can be corrected by means of the DEF PAR section of S1, located on the FCD-E1 main board.

Set the DEF PAR section of S1 as follows:

- **OFF** – In this position, you can define the desired supervisory port parameters.
- **ON** – Set the switch section to ON to restore the default supervisory port parameters.

Preparation of Supervision Terminal

Configure the terminal for the communication parameters used by the CONTROL DCE port, select the full-duplex mode, and turn the terminal echo off. For the preliminary configuration session, always use the default communication parameters.

Connect the terminal RS-232 communication port to the CONTROL DCE port.

Initial Configuration

Perform the procedure explained below. If you need detailed instructions and explanations regarding each command, refer to *Appendix D*.

For detailed instructions regarding the use of the FCD-E1 command line interface, refer to the *Using the Explicit Command Mode* on page *4-15*.

Loading of Default Parameters

To load the default parameters, enter the **INIT DB** command.

Selecting the Supervisory Terminal Control Sequences

Select the terminal control sequences for the terminal type in use by entering the command **DEF TERM 'terminal_type'**. **'terminal_type'** stands for one of the following types: VT52, VT100, TV920, FREEDOM100, FREEDOM220.

In case your terminal requires control sequences differing from those used by the terminals listed above, type the command **F** and enter your terminal control sequences.

Configuration of Terminals

To prepare the FCD-E1 system for configuration by means of a supervision terminal, perform the activities described below.

Even in case you will manage the FCD-E1 system using only Telnet hosts and/or SNMP management stations, first you must use the supervision terminal to configure the supervisory port and the SNMP agent.

CONTROL DCE Port Configuration

Configure the CONTROL DCE port of the FCD-E1 system by entering the command **DEF SP**. You will see the supervisory port configuration data form. A typical form with the default values is shown below:

```
SPEED      DATA      PARITY      INTERFACE      CTS      DCD_DEL
DSR
9600       8         NO          DCE            =RTS     0_MSEC
ON
POP_ALM      PWD      LOG_OFF      AUXILIARY_DEVICE
NO           NO       NO           TERMINAL
```

Setting the Time and Date for the Internal Clock

Set the time of the internal clock of the FCD-E1 system by entering the command **TIME**, and then set the date by entering the command **DATE**.

At this stage, you can start using the supervision terminal to perform FCD-E1 configuration activities.

Activating Password Protection

To prevent unauthorized modification of the FCD-E1 system parameters, you can use a password. Set the password by setting PWD in DEF SP to 'yes' and then entering the command **DEF PWD**.

Configuration of Telnet or SNMP Management

To prepare the FCD-E1 system for configuration by means of Telnet hosts and/or SNMP management stations, use the supervision terminal to configure the supervisory port and the SNMP agent as explained below.

SNMP Agent Configuration

- Define the FCD-E1 system name, using the **DEF NAME** command.
- Define the SNMP agent parameters using the **DEF AGENT** command. The IP address and the subnet mask, as well as the various community names must match those of the IP host. A typical SNMP agent parameters data form is shown below:

```
TELNET_APATHY_TIME
10 MIN
IP_ADDRESS          :XXX.XXX.XXX.XXX
MAC ADDRESS         :XXX.XXX.XXX.XXX.XXX.XXXX
READ COMMUNITY      :public
WRITE COMMUNITY     :private
TRAP COMMUNITY IS : public
```

where X stands for the digits of the IP and MAC addresses.

Configuration of FCD-E1 Ports for Telnet and SNMP Access

To use a FCD-E1 serial port for Telnet and SNMP access, use the **DEF SP** command and select the following parameters:

- Select the appropriate data rate in the **SPEED** field. Do not select **AUTO**.
- Select **NMS-SLIP** in the **AUXILIARY DEVICE** field.

At this stage, you can start using Telnet hosts or SNMP management stations to perform FCD-E1 configuration activities.

4.4 FCD-E1 Supervision Language

This section presents the set of commands available for the FCD-E1 supervision terminal.

For a detailed description of the FCD-E1 command set, refer to *Appendix D*.

The FCD-E1 operating mode, and all of its functions, is controlled by a set of configuration parameters. The user, in accordance with the requirements of the specific applications can determine these parameters.

The preparation of the desired set of configuration parameters is made in accordance with a set of rules, which together form the FCD-E1 supervision language. The supervision language is used to communicate with the central control subsystem of the FCD-E1, using a supervision terminal physically connected to the supervisory port, CONTROL DCE. Telnet hosts can also use the same language.

Command Modes

The supervision terminal supports two command modes, which are simultaneously available:

- Explicit command mode, which uses commands comprising of easily, remembered words. The basic command may be followed by parameters, e.g., to identify a specific port, and by command line switches. The use of the explicit command mode is covered in the *Using the Explicit Command Mode* section on page 4-15.
- Menu-driven, or mnemonic, command mode. This mode uses commands consisting of short combinations of letters. Since the mnemonics may be difficult to remember, the user can display the commands in the form of a menu tree, which leads the user in a maximum of four steps to the desired command. The use of the menu-driven command mode is covered in the *Using the Menu-Driven Command Mode* section on page 4-17.

Index of Commands

Table 4-2 lists the explicit command set in alphabetical order, and Table 4-3 lists the mnemonics in alphabetical order. For each command, you will find a cross-reference to the equivalent command in the alternative mode.

Table 4-2. Explicit Command Set Index

Command	Purpose	Options	Mnemonic
BYE	End current Telnet session		MY
CLR ALM	Clear alarms stored in the FCD-E1 alarm buffer	/A	CA
CLR LP LOC ANA ML	Clear user-initiated test or loopback		CLAM
CLR LP REM ANA ML			CRAM
CLR LP LOC DIG ML			CLDM
CLR LP REM DIG ML			CRDM
CLR LP LOC ANA SL			CLAS
CLR LP REM ANA SL			CRAS
CLR LP LOC DIG SL			CLDS
CLR LP REM DIG SL			CRDS
CLR LP BERT SL			CBS
CLR LP INBAND SL			CIS
CLR LP LOC CH1			CL1
CLR LP REM CH1			CR1
CLR LP BERT CH1			CB1
CLR LP INBAND CH1			CI1
CLR LP LOC CH2			CL2
CLR LP REM CH2			CR2
CLR LP BERT CH2			CB2
CLR LP INBAND CH2			CI2
CLR LP ML			–
CLR LP SL			–
CLR LP CH1			–
CLR LP CH2			–
DATE	Set the date for the FCD-E1 internal clock		MA

Table 4-2. Explicit Command Set Index (Cont.)

Command	Purpose	Options	Mnemonic
DEF AGENT	Define the SNMP agent configuration parameters		DG
DEF ALM MASK	Define the alarms to be masked (ignored)		DA
DEF AR	Control the use of traps for alarms reporting		–
DEF BERT CH 1 DEF BERT CH 2 DEF BERT SL	Define the type of test sequence to be used for BER testing on the corresponding data channel or sublink		DB1 DB2 DBS
DEF CALL	Define the dial-out parameters for the dial-out port		DC
DEF CH 1 DEF CH 2	Configure the parameters of the corresponding channel		D1 D2
DEF DNLOAD ML	Define the main link inband management parameters		DDM
DEF DNLOAD SL	Define the sublink inband management parameters		DDS
DEF DP	Define the parameters of the dial-out port		DO
DEF MANAGER LIST	Define or modify the network management stations to which the SNMP agent of this FCD system will send traps		–
DEF ML	Configure main link parameters		DM
DEF NAME	Define the logical name of the FCD-E1		DN
DEF NODE	Define the node number of the FCD-E1		DX
DEF PWD	Define a new password		DW
DEF ROUTE	Define the network management stations to be statistically routed via the supervisory port		–
DEF SL	Configure sublink parameters		DS
DEF SP	Configure supervisory port parameters		DP
DEF SYS	Configure system parameters		DY
DEF TERM	Reset the terminal control codes to 0		–
DEF TERM VE100 DEF TERM TV920 DEF TERM VT52 DEF TERM FREEDOM/100 DEF TERM FREEDOM/200	Select the control codes for one of the standard terminal types		DT10 DT92 DT52 DTF1 DTF2
DSP AGENT			SE
DSP ALM	Display the contents of the alarm buffer and optionally clear the buffer	/C /CA	SA
DSP BERT CH 1 DSP BERT CH 2 DSP BERT SL	Display the results of the last BER measurement made on the corresponding data channel or sublink	/I /R /S /C	SB1 SB2 SBS

Table 4-2. Explicit Command Set Index (Cont.)

Command	Purpose	Options	Mnemonic
DSP FDL ML	Display the last FDL message received by the FCD-E1 main link	/R	SFM
DSP FDL SL	Display the last FDL message received by the FCD-E1 sublink	/R	SFS
DSP HDR TST	Display the results of the last hardware self-test		SH
DSP PM ML	Display the contents of the main link performance monitoring registers, and optionally clear these registers	/C /CA	SPM
DSP PM SL	Display the contents of the sublink performance monitoring registers, and optionally clear these registers	/C /CA	SPS
DSP REM AGENT	Display information on the remote SNMP agents handled by the FCD-E1 IP router		SG
DSP ST CH1 DSP ST CH2	Display status information on the corresponding channel		SS1 SS2
DSP ST ML	Display status information on the main link		SSM
DSP ST SL	Display status information on the sublink		SSS
DSP ST SYS	Display system status		SSY
DSP TS	Display information on the use and type of main link time slots		ST
F	Define control codes for the supervision terminal		MF
EXIT	End the current control session		MX
HELP	Displays a concise index of commands and option switches		MH
INIT DB	Load the default configuration instead of the user's configuration.		ID
LP LOC ANA ML LP REM ANA ML LP LOC DIG ML LP REM DIG ML LP LOC ANA SL LP REM ANA SL LP LOC DIG SL LP REM DIG SL LP LOC CH1 (CH2) LP REM CH1 (CH2) LP BERT CH1 (CH2) LP BERT SL LP INBAND SL LP INBAND CH1 (CH2)	Activate a user-controlled test or loopback		LLAM LRAM LLDM LRDM LLAS LRAS LLDS LRDS LL1 (LL2) LR1 (LR2) LB1 (LB2) LBS LIS LI1 (LI2)
PASSWORD=	Enter the user password at the start of a new session; followed by the password itself		MP
RESET	Perform a reset of the FCD-E1		–
TIME	Set the time of the FCD-E1 internal clock		MT

Table 4-3. Mnemonic Command Set Index

Mnemonic	Purpose	Explicit Command Format
CA	Clear alarms stored in the FCD-E1 alarm buffer	CLR ALM
CB1	Stop the BERT test on channel 1	CLR LP BERT CH1
CB2	Stop the BERT test on channel 2	CLR LP BERT CH2
CBS	Stop the BER test on sublink	CLR LP BERT SL
CI1	Deactivate remote inband-activated loopback on channel 1	CLR LP INBAND CH1
CI2	Deactivate remote inband-activated loopback on channel 2	CLR LP INBAND CH2
CIS	Deactivate inband loopback on sublink	CLR LP INBAND SL
CL1	Deactivate local loopback on channel 1	CLR LP LOC CH1
CL2	Deactivate local loopback on channel 2	CLR LP LOC CH2
CLAM	Deactivate local analog loopback on the main link	CLR LP LOC ANA ML
CLAS	Deactivate local analog loopback on the sublink	CLR LP LOC ANA SL
CLDM	Deactivate local digital loopback on the main link	CLR LP LOC DIG ML
CLDS	Deactivate local digital loopback on the sublink	CLR LP LOC DIG SL
CM	Display the main link clear loopback commands submenu, for orientation in using the mnemonic commands	–
CR1	Deactivate remote loopback on channel 1	CLR LP REM CH1
CR2	Deactivate remote loopback on channel 2	CLR LP REM CH2
CRAM	Deactivate remote analog loopback on the main link	CLR LP REM ANA ML
CRAS	Deactivate remote analog loopback on the sublink	CLR LP REM ANA SL
CRDM	Deactivate remote digital loopback on the main link	CLR LP REM DIG ML
CRDS	Deactivate remote digital loopback on the sublink	CLR LP REM DIG SL
CS	Display the sublink clear loopback commands submenu, for orientation in using the mnemonic commands	–
C1	Display the channel 1 clear loopback commands submenu, for orientation in using the mnemonic commands	–
C2	Display the channel 2 clear loopback commands submenu, for orientation in using the mnemonic commands	–
D1	Configure the parameters of channel 1	DEF CH 1
D2	Configure the parameters of channel 2	DEF CH 2
DA	Define the alarms to be masked (ignored)	DEF ALARM MASK
DB	Display the BER tests commands submenu, for orientation in using the mnemonic commands	–
DB1	Define the type of test sequence to be used for BER testing on channel 1	DEF BERT CH 1

Table 4-3. Mnemonic Command Set Index (Cont.)

Mnemonic	Purpose	Explicit Command Format
DB2	Define the type of test sequence to be used for BER testing on channel 2	DEF BERT CH 2
DBS	Define the type of test sequence to be used for BER testing on sublink	DEF BERT SL
DC	Define the dial-out parameters for the dial-out port	DEF CALL
DD	Display the download configuration commands submenu, for orientation in using the mnemonic commands	–
DDM	Define the main link inband management parameters	DEF DNLOAD ML
DDS	Define the sublink inband management parameters	DEF DNLOAD SL
DG	Define the SNMP agent configuration parameters	DEF AGENT
DM	Configure main link parameters	DEF ML
DN	Define the logical name of the FCD-E1	DEF NAME
DO	Define the parameters of the dial-out port	DEF DP
DP	Configure supervisory port parameters	DEF SP
DS	Configure sublink parameters	DEF SL
DT	Display the terminal codes commands submenu, for orientation in using the mnemonic commands	–
DE10	Select the control codes for use with VT-100 terminals	DEF TERM VE100
DT52	Select the control codes for use with VT-52 terminals	DEF TERM VT52
DT92	Select the control codes for use with TV-920 terminals	DEF TERM TV920
DTF1	Select the control codes for use with Freedom 100 terminals	DEF TERM FREEDOM/100
DTF2	Select the control codes for use with Freedom 200 terminals	DEF TERM FREEDOM/200
DW	Define new password, and/or display the current password	DEF PWD
DX	Define the node number of the FCD-E1	DEF NODE
DY	Configure system parameters	DEF SYS
ID	Load the default configuration instead of the user's configuration.	INIT DB
LB1	Activate BER test on channel 1	LP BERT CH1
LB2	Activate BER test on channel 2	LP BERT CH2
LBS	Activate BER test on sublink	LP BERT SL
LI1	Activate inband-activated loopback on channel 1	LP INBAND CH1
LI2	Activate inband-activated loopback on channel 2	LP INBAND CH2
LIS	Activate inband-activated loopback on sublink	LP INBAND SL
LL1	Activate local loopback on channel 1	LP LOC CH1

Table 4-3. Mnemonic Command Set Index (Cont.)

Mnemonic	Purpose	Explicit Command Format
LL2	Activate local loopback on channel 2	LP LOC CH2
LLAM	Activate local analog loopback on the main link	LP LOC ANA ML
LLAS	Activate local analog loopback on the sublink	LP LOC ANA SL
LLDM	Activate local digital loopback on the main link	LP LOC DIG ML
LLDS	Activate local digital loopback on the sublink	LP LOC DIG SL
LM	Display the main link loopback commands submenu, for orientation in using the mnemonic commands	–
LR1	Activate remote loopback on channel 1	LP REM CH1
LR2	Activate remote loopback on channel 2	LP REM CH2
LRAM	Activate remote analog loopback on the main link	LP REM ANA ML
LRAS	Activate remote analog loopback on the sublink	LP REM ANA SL
LRDM	Activate remote digital loopback on the main link	LP REM DIG ML
LRDS	Activate remote digital loopback on the sublink	LP REM DIG SL
LS	Display the sublink loopback commands submenu, for orientation in using the mnemonic commands	–
L1	Display the channel 1 loopback commands submenu, for orientation in using the mnemonic commands	–
L2	Display the channel 2 loopback commands submenu, for orientation in using the mnemonic commands	–
MA	Set the date for the FCD-E1 internal clock	DATE
MC	Display the clear commands menu, for orientation in using the mnemonic commands	–
MD	Display the define commands menu, for orientation in using the mnemonic commands	–
MF	Define the control codes for the supervision terminal	–
MH	Display a concise index of commands and option switches	H
MI	Display the initialization commands menu, for orientation in using the mnemonic commands	–
ML	Display the test and loopback commands menu, for orientation in using the mnemonic commands	–
MM	Display the main menu for orientation in using the mnemonic commands	-
MP	Enter the user password at the start of a new session; followed by the password itself	PASSWORD=
MS	Display the display commands menu, for orientation in using the mnemonic commands	–

Table 4-3. Mnemonic Command Set Index (Cont.)

Mnemonic	Purpose	Explicit Command Format
MT	Set the time of the FCD-E1 internal clock	TIME
MX	End the current control session	EXIT
MY	Exit telnet session	BYE
SA	Display the alarm buffer contents	DSP ALM
SB	Display the BER test results submenu, for orientation in using the mnemonic commands	–
SB1	Display the results of the last BER measurement on channel 1	DSP BERT CH1
SB2	Display the results of the last BER measurement on channel 2	DSP BERT CH 2
SBS	Display the results of the last BER measurement on sublink	DSP BERT SL
SE	Display agent	DSP Agent
SF	Display the FDL commands submenu	–
SFM	Display the last FDL message received by the FCD-E1 main link	DSP FDL ML
SFS	Display the last FDL message received by the FCD-E1 sublink	DSP FDL SL
SG	Display information on the remote SNMP agents handled by the FCD-E1 IP router	DSP REM AGENT
SH	Display the results of the last periodical hardware self-test	DSP HDR TST
SP	Display the performance display commands submenu, for orientation in using the mnemonic commands	–
SPM	Display the contents of the main link performance monitoring registers, and optionally clear these registers	DSP PM ML
SPS	Display the contents of the sublink performance monitoring registers, and optionally clear these registers	DSP PM SL
SS	Display the status display commands submenu, for orientation in using the mnemonic commands	–
SS1	Display status information on channel 1	DSP ST CH1
SS2	Display status information on channel 2	DSP ST CH2
SSM	Display status information on the main link	DSP ST ML
SSS	Display status information on the sublink	DSP ST SL
SSY	Display system status	DSP ST SYS
ST	Display information on the use and type of main link time slots	DSP TS

4.5 Using the Explicit Command Mode

This section presents the supervision language syntax, usage and set of commands used in the explicit mode.

Explicit Mode Command Syntax

- Commands can only be entered when the FCD-E1 supervisory port prompt is displayed. The prompt is **FCD>**, and it always appears at the beginning of a new line. The cursor appears to the right of the prompt (except when using a multidrop configuration).
- Commands are case-insensitive, e.g., you can type commands in either lower case and/or upper case letters and they will be interpreted as upper case only. Logical names entered in the user-defined section of the prompt can however use lowercase and uppercase letters, as entered by the user.
- To correct typing errors, backspace by pressing the BACKSPACE key until the error is cleared, and then type the correct characters.
- To clear the whole command string before its entry is completed, press CTRL+C (that is, hold the CTRL key down and type C). This will result in the display of the FCD-E1 prompt, and a new command can be entered.
- Use space as a separator between command fields and/or parameters.
- Leading zeroes may be omitted.
- Commands must end with pressing the **<Enter>** key.
- To obtain help, type H.
- Commands addressed to one of the FCD-E1 ports include a port identifier:
  - The main link port has the identifier ML.
  - The sublink port has the identifier SL.
  - The data channel or Ethernet port has the identifier HS.

Command Options

The following general types of options are available with some commands. See details in *Table 4-2*.

Table 4-4. Command Options

Option	Meaning	Example of Usage
/A	All	CLR ALM /A Clears all the alarms stored by the alarm buffer
/C	Clear	DSP BERT /C Display BERT results and clear the BER counter
/CA	Clear all	DSP PM /CA Display the performance monitoring counters, and then clear (reset to 0) all the counters
/R	Repeat automatically command execution. Available only when node address is 0; not available with Telnet	DSP BERT CH 1 /R Enables you to monitor the updated results of the bit error rate test being run on channel 1 of the FCD-E1

Command Protocol

Command Evaluation and Execution

- If Autobaud is on, start any session by pressing the **<Enter>** key three times in sequence. This ensures identification of terminal data rate.
- When the FCD-E1 uses a non-zero node address, it expects an address before responding to the terminal commands. No response occurs until the node number is received and acknowledged by the addressed FCD-E1. The address is in the range of 1 through 255 (0 indicates that the selective addressing function is disabled). The address is a prefix sent in the following format: **Node<SP>nnn<SP>**.

  The echoing of the node address part, i.e., Node <SP> nnn <SP> indicates acknowledgment, where **<SP>** stands for space.
- When password protection is on, the addressed FCD-E1 waits for the password before continuing. After the correct password is received, FCD-E1 sends the working prompt, **FCD>**.
  If password protection is off, this step is omitted and the working prompt appears after the node address conditions are fulfilled.
- After the working prompt is displayed, every character typed on the terminal keyboard is immediately evaluated by FCD-E1 and echoed to the terminal screen. Full duplex communication with the terminal is therefore necessary, to provide on-line feedback to the terminal operator.
- In case an error is detected during command evaluation, the command is not executed. Instead, FCD-E1 sends the erroneous command back to the terminal, and you will see BAD COMMAND in the next row. The correct command must then be sent again.
- The command is executed only after it is validated. After command execution is completed, you will see the date and time, followed by the working prompt.
- Pressing CTRL+C can interrupt command execution. This will result in the display of the FCD-E1 prompt, and a new command can be entered. Use the BREAK key to stop the automatic repetition of commands (/R option).
- If you are ***not*** using the multidrop mode, then you can edit previous commands by pressing CTRL+A. FCD-E1 stores the last 10 commands in a special buffer, and each CTRL+A pressing retrieves the previous command from that buffer. The retrieved command appears on the command line, and can be edited as desired.
- If you are ***not*** using the multidrop mode, press CTRL+D to execute again the last command.

Command Fields

- When a command has several fields, use the space bar to move the cursor among the various fields. However, for some commands, the **<Enter>** key is used instead: this is indicated in the command description.
- When a field has a limited range of values, the available values can be displayed by scrolling. Bringing the cursor to the desired field, and then pressing the F (forward) or B (backward) key until the desired value is displayed performs scrolling.
- If a certain field is not applicable to the current command, the field shows **N/A** and scrolling is not possible. **N/A** will usually appear in fields of a DEF command that specify parameters not used in the selected operating mode.
- To correct typing errors, backspace by pressing the BACKSPACE key until the error is cleared, and then type again the correct command.
- For commands, which include more than one page, press **<Enter>** to continue to the next page. Command evaluation starts only when the **<Enter>** key is pressed on the last page of the command data form.

Ending a Session

FCD-E1 ends the current session in the following cases:

- When the EXIT command is received (for Telnet sessions, use BYE).
- After no terminal activity is detected for the selected log-off time-out interval, 3 minutes (for Telnet sessions, the disconnect interval is determined by the Telnet apathy time).

After the session is ended, it is necessary to enter the correct password again to start a new session.

4.6 Using the Menu-Driven Command Mode

Mnemonic Mode Command Syntax

The mnemonic mode command syntax is similar to the explicit mode. The main rules are as follows:

- Commands can only be entered when the FCD-E1 supervisory port prompt, **FCD>**, is displayed.
- Commands are case-insensitive, e.g., you can type commands in either lower case and/or upper case letters.
- Commands must end with pressing the **<Enter>** key.
- Do not add parameters after the command (except data channel commands) however, switches such as /A and /R can be used.

Using the Mnemonic Mode

To use the mnemonic mode, the only command that needs to be remembered is MM, the command that displays the top-level menu.

After entering the top-level menu, you can read the command needed to proceed to the next lower level, on the path to the command that performs the desired action.

Table 4-5 displays the mnemonic mode menu structure.

Table 4-5. Mnemonic Mode Menu Structure

MM	Main Menu			
	MA	Set the date for the FCD-E1 internal clock		
	MT	Set the time for the FCD-E1 internal clock		
	MX	End the current control session		
	MF	Define special supervision terminal codes		
	MP	Enter the user password at the start of a new session; followed by the password itself		
	MH	Display a concise index of commands and option switches		
	ME	Reserved		
	MY	Disconnet Telnet session		
	MS	**Display Commands Menu**		
		SA	Display the alarm buffer contents	
		ST	Display timeslots assignment	
		SE	Display agent	
		SH	Display the results of the last periodical hardware self-test	
		SG	Display information on the remote SNMP agents handled by the FCD-E1 IP router	
		SB	**Display BER test results submenu**	
			SB1	Display the results of the last BER measurement made on channel 1
			SB2	Display the results of the last BER measurement made on channel 2
			SBS	Display the results of the last BER measurement made on sublink
		SF	**Display FDL Menu**	
			SFM	FDL of main link
			SFS	FDL of sublink
		SS	**Display status menu**	
			SSY	Display system status information
			SSM	Display status information on the main link
			SSS	Display status information on the sublink
			SS1	Display status information on channel 1
			SS2	Display status information on channel 2
		SP	**Display performance monitoring menu**	
			SPM	Display contents of main link performance monitoring registers, and optionally clear them
			SPS	Display contents of sublink performance monitoring registers, and optionally clear them

Table 4-5. Mnemonic Mode Menu Structure (Cont.)

MM	Main Menu			
(Cont'd)	**MC**	**Clear Commands Menu**		
		CA	Clear alarms stored in the FCD-E1 alarm buffer	
		CM	**Main link clear commands submenu**	
			CLAM	Deactivate local analog loopback on the main link
			CLDM	Deactivate local digital loopback on the main link
			CRAM	Deactivate remote analog loopback on the main link
			CRDM	Deactivate remote digital loopback on the main link
		CS	**Sublink clear commands submenu**	
			CLAS	Deactivate local analog loopback on the sublink
			CLDS	Deactivate local digital loopback on the sublink
			CRAS	Deactivate remote analog loopback on the sublink
			CRDS	Deactivate remote digital loopback on the sublink
			CBS	Deactivate BER testing on the sublink
			CIS	Deactivate inband loop on the sublink
		C1	**Channel 1 clear loopback commands**	
			CL1	Deactivate local loopback on channel 1
			CR1	Deactivate remote loopback on channel 1
			CB1	Stop the BER test on channel 1
			CI1	Deactivate remote inband-activated loopback on channel 1
		C2	**Channel 2 clear loopback commands**	
			CL2	Deactivate local loopback on channel 2
			CR2	Deactivate remote loopback on channel 2
			CI2	Deactivate remote inband-activated loopback on channel 2
	MD	**Define Menu**		
		DM	Configure main link parameters	
		DS	Configure sublink parameters	
		D1	Configure the parameters of channel 1	
		D2	Configure the parameters of channel 2	
		DY	Configure the system parameters	
		DP	Configure supervisory port parameters	
		DX	Define the node number of the FCD-E1	
		DN	Define the logical name of the FCD-E1	
		DW	Define the new password, and/or display the current password	
		DF	Reserved	
		DA	Define the alarms to be masked (ignored)	
		DC	Define CALL OUT parameters	
		DO	Define DIAL PORT parameters	

Table 4-5. Mnemonic Mode Menu Structure (Cont.)

MM	**Main Menu**			
		DT	**Define terminal function parameters submenu**	
			DE10	Select the control codes for use with VT-100 terminals
			DT92	Select the control codes for use with TV-920 terminals
			DT52	Select the control codes for use with VT-52 terminals
			DTF1	Select the control codes for use with Freedom 100 terminals
			DTF2	Select the control codes for use with Freedom 200 terminals
		DB	**Display BER commands submenu**	
			DB1	Define the type of test sequence to be used for BER testing on channel 1
			DB2	Define the type of test sequence to be used for BER testing on channel 2
			DBS	Define the type of test sequence to be used for BER testing on sublink
		DD	**Display download configuration commands menu**	
			DDM	Define the main inband management parameters
			DDS	Define the sublink inband management parameters
		DG	**Define the SNMP agent configuration parameters**	
	MI	**Initialization Commands Menu**		
		ID	**Load the default configuration instead of the user's configuration.**	
	ML	**Test and Loopback Commands Menu**		
		LM	**Main link loopback commands submenu**	
			LLAM	Activate local analog loopback on the main link
			LLDM	Activate local digital loopback on the main link
			LRAM	Activate remote analog loopback on the main link
			LRDM	Activate remote digital loopback on the main link
		LS	**Sublink loopback commands submenu**	
			LLAS	Activate local analog loopback on the sublink
			LLDS	Activate local digital loopback on the sublink
			LRAS	Activate remote analog loopback on the sublink
			LRDS	Activate remote digital loopback on the sublink
			LBS	Activate BER testing on the sublink
			LIS	Activate inband loop on the sublink
		L1	**Channel 1 loopback commands submenu**	
			LL1	Local loop
			LR1	Activate remote loopback on channel 1
			LB1	Activate BER test on channel 1
			LI1	Activate inband-activated loopback on channel 1

Table 4-5. Mnemonic Mode Menu Structure (Cont.)

MM	**Main Menu**		
	L2	**Channel 2 loopback commands submenu**	
		LL2	Activate remote loopback on channel 2
		LR2	Activate remote loopback on channel 2
		LB2	Activate BER test on channel 2
		LI2	Activate inband-activated loopback on channel 2

4.7 Supervision Terminal Operating Instructions

Before using the supervision terminal, make sure the preparations listed in the *Configuration Sequence* section on page *4-1* and the *Preliminary Configuration* on page *4-5* are completed, and all the relevant equipment has been turned on.

Starting a Single FCD-E1Session

When the terminal is used to control a single FCD-E1, always assign node address 0 to the FCD-E1. Use the following start-up sequence to connect to an FCD-E1 assigned node number 0.

1. If you use the AUTO (Autobaud) mode, press the **<Enter>** key three times. This allows the FCD-E1 to identify the terminal data rate.
2. Assuming that the FCD-E1 successfully identified the data rate of the supervision terminal, you will be notified if the FCD-E1 failed the power-up self-test:
   - If you see **`FCD SELFTEST FAILED`**, the FCD-E1 must be repaired before you can continue using it.
   - If FCD-E1 successfully passed the power-up self-test, it sends the following message:

     `FCD SUPERVISORY PORT ONLINE`
3. By now, the FCD-E1 prompt should already be displayed on the terminal screen, after the on-line announcement.

   If you see **`PASSWORD>`**, this indicates that password protection is enabled. In this case, type the current case-sensitive password (four to eight characters). The default password is **RAD**.
   If your password is accepted, the **FCD>** prompt is displayed.
4. FCD-E1 is now in session, under your control. On your terminal, you will see the prompt: **`FCD>`**

   On the FCD-E1 front panel, you will see the message **`TERMINAL ON LINE`**. The front panel controls are disabled as long as FCD-E1 is under remote control.

Note *While the supervision terminal is in session with the FCD-E1, the FCD-E1 local operator can regain control by disconnecting the cable from the FCD-E1 CONTROL DCE connector, or by sending the EXIT command.*
The FCD-E1 will automatically return to front panel control if no commands are received for a certain period of time (controlled by the LOG_OFF parameter). This time-out can however be disabled.

Starting a Multiple FCD-E1Session

When one terminal is used to control several FCD-E1 connected via modems, node addresses are assigned to each FCD-E1. The node addresses, in the range of 1 through 255 are assigned during the first session, by means of the command DEF NODE. Use the following procedure to establish a session with a specific FCD-E1.

Note *If you are using a multidrop configuration, do not assign address 0 to the FCD-E1 connected to this terminal.*

1. Press the **<Enter>** key three times.
2. Type **NODE**, space, the desired FCD-E1 node address and another space then type the desired command and press **<Enter>**. For example, with node address 234, type:
   NODE<SP>234<SP> 'command' <Enter>
   If the addressed FCD-E1 does not use password protection, it will immediately execute the command.
   If the addressed FCD-E1 is password protected, you will see the prompt:
   PASSWORD>
3. Type again the node address and then the password.
   For example, for node address 234, type:
   NODE<SP>234<SP>password=<SP>'password'<Enter>
   If the password is correct, the FCD-E1 will execute the command. Otherwise, you will see PASSWORD>.

Control Sessions

1. During the control session, type the desired commands at the terminal keyboard. You must see the FCD-E1 echo character by character. If a bad command appears, backspace to clear the error, then type again the correct character.
   - When you see the correct and complete command in the echo line, press **<Enter>** to execute the command. The FCD-E1 will process the command and display the appropriate response.
     At the end of the command execution, the FCD-E1 displays the current time and date, and then provides a new prompt for the next command line.
   - If you changed your mind, and want to abort the command, press BREAK. You will again receive the prompt, so you can enter another command.

Note *You can use BREAK to stop automatic repetition of commands sent with the /R option.*

2. If your command is not correct, the FCD-E1 will not execute it, but will echo again the command, with a BAD COMMAND message in the following line. Type again the correct command.
3. If the terminal screen fills up during the exchange with the FCD-E1, you will see the message:
   HIT ANY KEY TO CONTINUE
   After pressing any key except BREAK, the terminal scrolls to the next page.

Ending a Control Session

1. To end the control session, type:
   EXIT
   The command used to end Telnet sessions is **BYE**.
2. The FCD-E1 prompt will disappear. Now you can control the FCD-E1 from its front panel.

Note *A control session may also be terminated by the FCD-E1 if the idle disconnect time-out is enabled, or when the DTR line switches to the inactive (OFF) state.*

Chapter 5

Configuring Typical Applications

5.1 Configuring the FCD-E1 Application

This chapter provides configuration guidelines for FCD-E1 systems.

The configuration activities presented in this chapter require that the FCD-E1 be first configured using a standard ASCII terminal, as explained in *Chapter 4*.

However, after performing the preliminary configuration of the terminal and the FCD-E1 in accordance with *Chapter 4*, the same configuration activities can also be performed by means of a Telnet host, or an SNMP network management station.

For general information regarding the supervision language syntax, usage and commands, refer to *Chapter 4*.

Detailed descriptions of each command appear in *Appendix D*.

5.2 Outline of General Configuration Procedure

To prepare a typical FCD-E1 system for operation in accordance with customer's requirements, perform the following activities in the order given in *Table 5-1*.

Table 5-1. Outline of Configuration Procedures

Step	Activity	Reference
1	Perform the preliminary configuration	*Chapter 4*
2	Define system configuration	DEF SYS
3	Configure the FCD-E1 main link	DEF ML
4	Configure each FCD-E1 port and its connections to the main link	DEF SL DEF CH1 DEF CH2

Table 5-1. Outline of Configuration Procedures (Cont.)

Step	Activity	Reference
5	Define the general system parameters	DEF AGENT DEF MANAGER LIST DEF ROUTE DEF NAME DEF PROMPT DEF PWD
6	Define dial-up parameters (when applicable)	DEF CALL
	Define alarm handling parameters	DEF ALM MASK DEF AP DEF AR

5.3 Configuration Example

This section illustrates the procedure details for configuring two FCD-E1 units, using a supervision terminal, for a typical application (see *Figure 5-1*).

In this application, two FCD-E1 units, each having one data channel and a sublink, are interconnected via the E1 network and managed by a RADview network management station attached to a DXC unit. The data channel rate is 128 kbps, the number of voice channels to be connected between the two PBXs is 10, and the management station is connected to both FCD-E1 units via the main links.

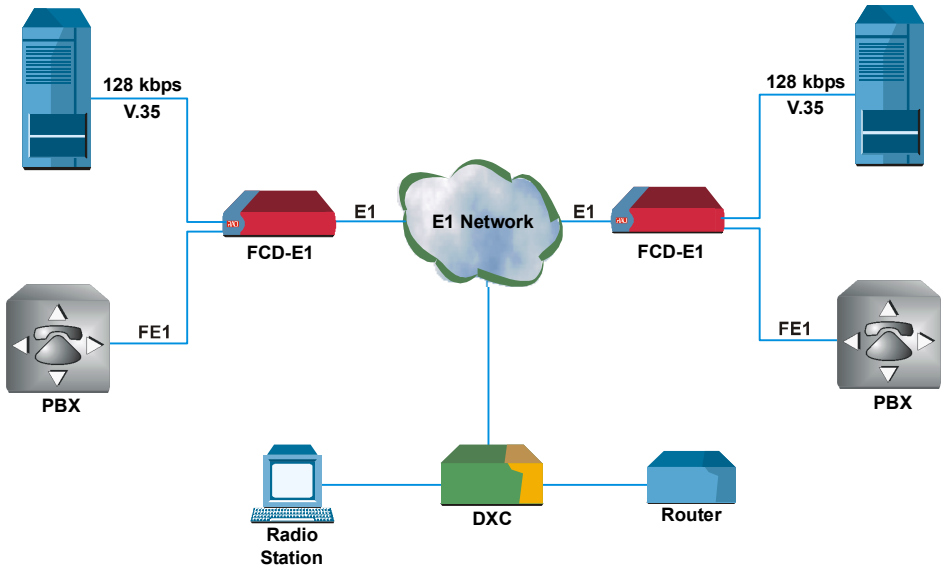


Figure 5-1. FCD-E1 Application for Configuration Examples Interconnected by an E1 Network

Configuring the Local FCD-E1

Configure General System Parameters

1. Type **INIT DB** to reset the FCD-E1 database to the default parameters.
2. Type **DEF TERM VT-100** to configure the control port to operate with the terminal control codes of the VT-100 terminal.
3. Type **DEF SP** to configure the control port.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
SPEED     STOP_BITS     PARITY     INTERFACE     CTS     DCD_DEL
DSR
AUTO      8             NO         DCE           =RTS    0 MS
ON
POP_ALM   PWD   LOG_OFF  CALL_OUT_TRIGER  ACTIVATE_CALL_OUT
AUXILIARY_DEVICE
NO        NO    NO       NONE             ANY CASE
TERMINAL
```

4. Type **DEF MANAGER LIST** to configure the FCD-E1 to accept one RADview management station:
   - The RADview station IP address is 192.114.029.201
   - The total number of managed units is 16; therefore the subnet mask is 255.255.255.240.

   A typical data form, as seen after the rows used to define the first management station have been filled in, is shown below:

```
MANAGER 1 IP ADDRESS        192.114.029.201
MANAGER 1 SUBNET MASK       255.255.255.240
```

5. Type **DEF AGENT** to configure the SNMP agent parameters:
   - The FCD-E1 management IP address is 192.114.029.209
   - Write community used by the RADview station: RAD
   - The other parameters can be left at their factory defaults.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
OLD AGENT PARAMETERS
- - - - - - - - - - - - - -
IP_ADDRESS IS             :   = 0.0.0.0
READ COMMUNITY IS         :   = public
WRITE COMMUNITY IS        :   = private
TRAP COMMUNITY IS         :   = public

TELNET_APATHY_TIME
10 MIN
IP_ADDRESS IS             :   = 192.114.029.209
READ COMMUNITY IS         :   = public
WRITE COMMUNITY IS        :   = RAD
TRAP COMMUNITY IS         :   = public
```

6. Type **DEF DNLOAD ML** to configure the FCD-E1 inband management parameters for the main link:
   - Management mode: Frame Relay
   - Network management traffic carried in timeslot 30.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
DNLOAD MODE
FRAME_RL
TS_NUM     SPEED
30          64
```

Configure Main Link Parameters

Type **DEF ML** to define the required main link parameters:

- E1 link interface operating mode: LONG
- Framing mode: G.732N
- Enable the CRC-4 function (YES)
- Set the idle timeslot code to 7F
- Enable transparent reporting of sub link alarms through the main link (RAI = ENABLE).

After configuration, the following display appears:

FRAME	CRC-4	SYNC	RX_GAIN	IDLE_TS_CODE	RAI
G732N	YES	CCITT	LONG	3F	ENABLE

Configure Sub Link Parameters

Type **DEF SL** to define the required sub link parameters:

- E1 link interface operating mode: SHORT
- Framing mode: G.732S
- Enable the CRC-4 function (YES)
- Set the idle timeslot code to 7F
- Enable transparent reporting of sub link alarms through the main link (RAI = ENABLE)

- Use the out-of-service code 3F
- Transfer 10 subscriber timeslots and the signaling timeslot (timeslot 16) through the main link.

After configuration, the following display appears:

```
FRAME        CRC-4        SYNC       RX_GAIN      IDLE_TS_CODE
RAI
G732N        NO           CCITT      SHORT        7F
ENABLE

CGA          OOS_SIG      OOS_CODE
NONE          N/A         3F

MAP_MODE   START_TS   TS_TYPE   NUM_OF_TS
USER        N/A         N/A       N/A

TS    :    1       2       3       4       5       6       7       8
TYPE  :    DATA    DATA    NO      NO      NO      NO      VOICE   VOICE

TS    :    9       10      11      12      13      14      15      16
TYPE  :    VOICE   VOICE   VOICE   VOICE   VOIC    VOICE   VOICE   DATA

TS    :    17      18      19      20      21      22      23      24
TYPE  :    VOICE   NO      NO      NO      NO      NO      NO      NO

TS    :    25      26      27      28      29      30      31
TYPE  :    NO      NO      NO      NO      NO      DEDIC   NO
```

Configure Data Channel Parameters

Type **DEF CH 1** to define the data channel characteristics and connect it to the main link timeslots 1 and 2.

After configuration, the following display appears:

```
MULTIPLIER    SPEED     FIFO_SIZE     CLOCK MODE     CTS
CLOCK_POLARITY
64            128       AUTO          DCE            ON      NORMAL

MAP_MODE       START_TS       TS_TYPE
SEQ             1             DATA

TS    :    1       2       3       4       5       6       7       8
TYPE  :    DATA    DATA    NO      NO      NO      NO      NO      NO

TS    :    9       10      11      12      13      14      15      16
TYPE  :    NO      NO      NO      NO      NO      NO      NO      NO

TS    :    17      18      19      20      21      22      23      24
TYPE  :    NO      NO      NO      NO      NO      NO      NO      NO

TS    :    25      26      27      28      29      30      31
TYPE  :    NO      NO      NO      NO      NO      DEDIC   NO
```

Check Main Link Timeslot Assignment

Type **DSP TS** to check main link timeslot assignment.

The resulting display appears:

```
TS :    01     02     03     04     05     06     07     08     09     10
TYPE :  DATA   DATA   NC     NC     NC     NC     VOICE  VOICE  VOICE  VOICE
DEST :  CH1    CH1    NA     NA     NA     NA     SUB    SUB    SUB    SUB

TS :    11     12     13     14     15     16     17     18     19     20
TYPE :  VOICE  VOICE  VOICE  VOICE  VOICE  DATA   VOICE  NC     NC     NC
DEST :  SUB    SUB    SUB    SUB    SUB    SUB    SUB    NA     NA     NA

TS :    21     22     23     24     25     26     27     28     29     30     31
TYPE :  NC     NC     NC     NC     NC     NC     NC     NC     NC     NC     NC
DEST :  NA     NA     NA     NA     NA     NA     NA     NA     NA     DEDIC  NA
```

Configure System Timing

Type **DEF SYS** to configure the FCD-E1 system timing:

- Lock FCD-E1 timing to the recovered main link clock
- Use the internal oscillator as fallback source.

After configuration, the following display appears:

```
CLK_MASTER     CLK_FBACK     DATE_FORMAT
ML             NONE          DD-MM-YYYY
```

Configuring the Remote FCD-E1

Repeat the procedure for the other FCD-E1.

Chapter 6

Troubleshooting and Diagnostics

6.1 Monitoring Performance

The performance evaluation and monitoring functions provided by the FCD-E1 for the main and sublinks are an important tool for testing and troubleshooting communication links.

This section describes the performance evaluation and monitoring functions.

The functions actually available depend on the use of the CRC-4 function on the corresponding link:

- **CRC-4 Enabled:** when the CRC-4 function enabled is used, it is possible to monitor end-to-end the data transmission performance.
  The error detection information is derived from the data payload, by performing a cyclic redundancy check (CRC). The resulting CRC checksum is transmitted in addition to the raw data bits.
  The receiving end recalculates the checksum and compares the results with the received checksum: any difference between the two checksums indicates that one or more bit errors are contained in the current data block being evaluated**.**
- **CRC-4 Disabled:** in this case, the FCD-E1 does not support the capabilities listed above. However, the FCD-E1 is capable of providing statistics of the bipolar violations.

Performance monitoring parameters are shown in *Table 6-1*. The parameters marked with an asterisk (*) indicate performance monitoring with the CRC-4 option enabled.

Displaying the Performance Data on the Front Panel LCD

➤ **To display the performance diagnostics data:**

1. Bring the cursor to the left-hand field of the top row (if not already there).
2. Scroll to display DIAGNOSTICS in the top row; the right-hand field of the top row shows ML, meaning that the displayed diagnostics data pertains to the main link. The second row shows the first performance item for the main link, and its current value. The displayed item depends on the link type and framing mode.
3. Bring the cursor to the left-hand field of the second row.
4. Scroll to see the other performance statistics.

5. Bring the cursor to the right-hand field of the top row.
6. Scroll to display SL; the second row shows the first performance item for the sublink, and its current value. The displayed item depends on the link type and framing mode.
7. Repeat steps 3, 4 to see the other statistics of the sublink; the second row shows the current value of the next item. Continue until the first item appears again.

Resetting the Performance Data Registers

The registers storing diagnostics data can be reset. To reset a register, display the register to be reset, bring the cursor to the left-hand field in the second row (under the register name) and press ENTER. To ensure that the collected data remains meaningful and correlated after a specific register is reset, FCD-E1 automatically performs the following operations:

- Since the data collected on a given link for the current interval and for the current 24-hour interval is correlated, pressing ENTER while any of the following CURR or L.TERM data items is displayed clears all the performance diagnostics registers, not only that appearing on the display: ES, UAS, SES, BES, LOFC, CSS, and the registers for CURR SECS, CURR DEG MIN, LST DEG MIN, and L.TERM INT.
- In case the ERROR CRC register of a given link is reset, the AVG ERR CRC register of that link is also reset, and vice versa.
- In case the BPV COUNT register of a given link is reset, the BPV WORST register of that link is also reset, and vice versa.

The only register that can be reset independently of the other registers is the ERROR EV register (available for links with ESF framing).

Displaying the Performance Data on a Supervision Terminal

The performance data can be displayed on the supervision terminal by means of the DSP PM command and for CRC-4 disabled by means of the DSP ST ML command, as explained in *Appendix D*.

By adding the /CA switch to the command, you can reset all the performance diagnostics registers.

Table 6-1. Performance Monitoring Parameters

Display	Name	Description
ERROR CRC*	Current CRC-4 error events	A CRC-4 error event is any multiframe containing a CRC error and/or OOF event. The number of CRC events in the current second is collected in a current CRC error events register.
AV ERR CRC*	Current average CRC-4 errors	The average number of CRC events per second. The average is updated every second. ***Note***: Register contents can be displayed at any time. When the CRC error events are displayed on the front-panel LCD, the register can be reset by pressing ENTER.
CURR ES*	Current errored seconds	An erred second is any second containing one or more CRC error events, or one or more OOF events, or one or more controlled slip events. The data is collected for the current 15-minute interval.
CURR UAS*	Current unavailable seconds	An unavailable second is any second in which a failed signal state exists. A failed signal state is declared when 10 consecutive severely errored seconds (SES) occur, and is cleared after 10 consecutive seconds of data are processed without a SES.
CURR SES*	Current severely errored seconds	A SES is a second with 832 or more CRC error events, or one or more OOF events. The data is collected for the current 15-minute interval.
CURR BES*	Current bursty errored seconds	A BES is a second with 2 to 831 CRC error events. The data is collected for the current 15-minute interval.
CURR LOFC*	Current loss of frame counter	The loss of frame (LOF) counter counts the loss of frame alignment events. The data is collected for the current 15-minute interval.
CURR CSS*	Current slip second counter	A CSS is a second with one or more controlled slip events. The data is collected for the current 15-minute interval.
CURR SECS*	Current seconds	The number of seconds in the current measurement interval. A measurement interval has 900 seconds (15 minutes).

Table 6-1. Performance Monitoring Parameters (Cont.)

FCD-E1 also provides local statistics support. These are long-term statistics gathered over the long-term interval (96 intervals of 15 minutes each, i.e., a total of 24 hours) for each link interface. The additional parameters included in this class are:

Display	Name	Description
L.TERM ES*	Long-term errored seconds	The total number of ES in the current 24-hour interval.
L.TERM UAS*	Long-term fail seconds	The total number of UAS in the current 24-hour interval.
L.TERM SES*	Long-term severely errored seconds	The total number of SES in the current 24-hour interval.
L.TERM BES*	Long-term bursty errored seconds	The total number of BES in the current 24-hour interval.
L.TRM LOFC*	Long-term loss of frame counter	The total number of LOF events in the current 24-hour interval.
L.TERM CSS*	Long-term slip second counter	The total number of CSS in the current 24-hour interval.
L.TERM INT*	Long-term interval	The number of valid 15-minute intervals in the previous 24 hour period.
CUR DEG MIN*	Current degraded minutes	The total number of degraded minutes in the current 24-hour interval. A degraded minute is a minute in which the bit error rate (BER) exceeded 1×10^{-6}. This number is updated every minute.
LST DEG MIN*	Last degraded minutes	The total number of degraded minutes in the last 24-hour interval. This number is updated every 24 hours.
BPV COUNT	Bipolar violations (BPV) count	The total number of bipolar violations counted in the last minute. This number is updated every minute.
BPV WORST	Bipolar violations worst count	The number of bipolar violations counted in the worst minute since the last resetting of the BPV count. This number is updated every minute.

* Indicates performance monitoring with the CRC-4 option enabled.

6.2 Detecting Errors

This section explains how to detect and fix errors and other problematic conditions in FCD-E1. Included in this section is information on:

- Power-Up Self-Test
- Configuration Error Messages

Power-Up Self-Test

Upon power-up, FCD-E1 automatically performs a self-test, to test critical circuit functions, and then decompresses and loads the operational software. During software decompression, the TST front-panel indicator flashes slowly, and then turns off.

- If a problem is detected during self-test, FCD-E1 automatically sends reports to the supervision terminal and the front panel LCD.

- If the self-test is successfully completed, FCD-E1 starts normal operation, and its front-panel indicators display the link status, as explained in *Chapter 3*.

Front-Panel LEDs

The status of FCD-E1 is indicated by the front-panel LEDs. For description of LED indicators and their functions refer to *Chapter 3*.

Configuration Error Messages

If FCD-E1 detects a configuration mismatch, it displays an appropriate configuration error message. These messages appear on either the LCD or the supervision terminal. Some of the messages are not available on the LCD.

On the control terminal, configuration error messages have the format ERROR, followed by a two-digit code and a short description of the error message after the error code. The LCD displays CONFIG ERROR followed by the error two-digit code, without description. *Table 6-2* lists the configuration error messages in order of their codes and explains each of them. Messages not available on the LCD are marked with an asterisk (*).

Table 6-2. FCD-E1 Configuration Error Messages

Error Code	Terminal Message	Description
ERROR 00	MASTER AND FALLBACK CLOCK ARE THE SAME	You are trying to select the same source as both master and fallback clock source. Check and change as required.
ERROR 01	INVALID MASTER CLOCK SOURCE	The channel you are trying to select as the master clock source is either not connected, or its clock mode is not DTE2. Check and change as required.
ERROR 02	INVALID FALLBACK CLOCK SOURCE	The channel you are trying to select as the master clock source is either not connected, or its clock mode is not DTE2. Check and change as required.
ERROR 03*	ILLEGAL DCD DELAY AND INTERFACE	You are trying to select a non-zero DCD DELAY after the FCD-E1 supervisory port interface has been set as DCE.
ERROR 04*	CONFLICT IN INTERFACE AND DSR PARAMETERS	You selected DSR=ON after the supervisory port interface has been set to DTE. The DSR=ON selection is valid only for DCE interface.
ERROR 05	TIME SLOT 16 OF E1-G732S FRAME IS MAPPED	You are trying to select the G732S framing mode while time slot 16 is assigned to a data channel, the sublink, or dedicated to inband management. Free time slot 16 before selecting the G732S framing.
ERROR 06	CONFLICT BETWEEN FRAME AND TIME-SLOT TYPES	You are trying to define a sub time slot as a voice time slot, but the main link framing mode is G732N (the voice type can be selected only when the framing mode is G732S). Check and change as required.

Table 6-2. FCD-E1 Configuration Error Messages (Cont.)

Error Code	Terminal Message	Description
ERROR 07	CHANNEL SPEED NOT MATCH OPEN NUMBER OF TS	The number of time slots currently allocated to a data channel is not equal to the number of time slots required to support the nominal data rate configured for that channel. Either increase the number of time slots, or reduce the channel data rate.
ERROR 08	FCD IN LOOP CAN'T UPDATE HARDWARE	When a test or loopback is active, it is not possible to change the FCD-E1 operating mode in accordance with the updated configuration parameters. You may see this message either after pressing ENTER, or after a update data base command has been received through the supervisory port (or inband management). You must first deactivate the test or loopback.
ERROR 09	CONFLICT BETWEEN CLOCK MODE AND FIFO SIZE	You are trying to select the DCE or DTE1 clock mode when the FIFO size is not AUTO. A specific FIFO size can be selected only for the DTE2 mode. Select AUTO.
ERROR 10	ILLEGAL TIME SLOT ALLOCATION	At least one main link time slot is being assigned to more than one user. Check the time slot assignment for each channel and for the sublink, with particular attention to automatic assignments (SEQ and ALT modes).
ERROR 11	TIME SLOT OUT OF RANGE	When using the SEQ or ALT mapping mode, the sum of the number of time slots requested for a data channel (or sub) and the starting time slot for that channel exceeds 31. Check and change as required.
ERROR 12	ILLEGAL UNFRAME CONFIGURATION	You are trying to configure UNFRAME mode incorrectly. Before selecting the UNFRAME mode, you must disconnect all the main link time slots from ports.
ERROR 13	ILLEGAL SPEED FOR AUXILIARY DEVICE	The AUTO (Autobaud) mode cannot be selected when the supervisory port is to support the SLIP protocol (AUX DEV parameter is set to SLIP-NMS).
ERROR 14*	WRONG IP ADDRESS	The syntax of the IP address is incorrect. The IP address must be entered in the dotted-quad format (four numbers in the range of 0 through 255, separated by periods), as explained in *Appendix B*.
ERROR 15*	WRONG MAC ADDRESS	The syntax of the MAC address is incorrect (the MAC address must be entered as six numbers in the range of 0 through 255, separated by periods).
ERROR 16	DEDICATE TIME-SLOT IS MAPPED	The time slot you are trying to select for use as the dedicated inband management time slot on that link is already assigned. Check and change as required.
ERROR 17	ILLEGAL DOWNLOAD MODE	You are trying to enable downloading while using the UNFRAME mode When using the UNFRAME mode, you must disable downloading.
ERROR 18	CONFLICT BETWEEN SYSTEM CLK AND CHANNEL CLK	A channel is configured to use the clock mode DTE2, but the master clock source is not configured to use that channel. Check and change as required.

Table 6-2. FCD-E1 Configuration Error Messages (Cont.)

Error Code	Terminal Message	Description
ERROR 019	DEDICATED TIME SLOT IS NOT MAPPED	Inband management is DEDIC TS or DEDIC FR and no timeslot is selected for management.
ERROR 020	CALL OUT OCCUPIED BY OTHER PORT	You can perform call-out only via the dial-out port or via the supervisory port.
WARN 021	RX INBAND ENABLE, ALL CH/S TRAFFIC STOP	You enabled the RX inband parameter on the sublink, which caused traffic disruption on the data channel(s).
ERROR 51	ILLEGAL PORT LOOP COMBINATION	You are trying to activate the remote loopback while the local loopback is already activated on the same port, or vice versa. First deactivate the currently active loopback.
ERROR 52	LOOP IS NOT ACTIVE	You are trying to deactivate a loopback or test that is not active. Check and change as required.
ERROR 53	CURRENT LOOP ALREADY BEING PERFORMED	You are trying to activate a loopback that is already active. Check and change as required.
ERROR 54	ILLEGAL PARAMETER FOR CURRENT CONFIGURATION	You are using a parameter that is not supported by this FCD-E1 version.
ERROR 55	ILLEGAL COMMAND FOR CURRENT PORT MODE	You are trying to select a parameter value that is not supported under the current link framing mode. Check and change as required.
ERROR 59*	REPETITIVE MODE CAN'T BE PERFORMED ON TELNET	You are trying to use a command with /R option while using Telnet for management. This is not allowed.
ERROR 60	CANT PERFORM LOOP - CHANNEL NOT CONNECTED	You are trying to activate a loopback on a channel that is not connected.
ERROR 61*	ILLEGAL FIELD VALUE	The value enterd in the specified field is not allowed. Check and correct as required.
ERROR 062	BERT/INBAND SL LOOP STOP ALL DATA TRAFFIC FROM CH2	You activated BER testing or inband loop on the sublink, which caused traffic disruption on channel 2.

6.3 Handling Alarms

FCD-E1 maintains an alarm buffer that can store up to 100 alarm messages.

Alarm Display

FCD-E1 displays alarm messages both on the front-panel LCD and on the supervision terminal. Alarms can be of two types, designated as ON/OFF and ON:

- An **ON/OFF-type** alarm is displayed only when the alarm condition is present, and is automatically removed when the condition is cleared (if the alarm is being displayed, it will disappear only when the display is refreshed by scrolling).
- An **ON-type** alarm persists even after the event that caused the alarm condition is cleared.

This manual uses the term *ON-state alarm*. An **ON-state alarm** is either an ON-type alarm or an ON/OFF-type alarm when its alarm condition is still present.

When an ON/OFF-type alarm changes its state from ON to OFF, it is not removed from the alarm buffer. Moreover, a new entry of this alarm is added to the alarm buffer. This feature enables you to view the alarm history on the terminal using the DSP ALM command. A typical display looks like this:

```
ALARM 21   SIGNAL LOSS      SL      ON   01:42:11
ALARM 21   SIGNAL LOSS      ML      ON   01:45:14
```

Alarm Messages

Table 6-3 presents in alphabetical order the alarm messages displayed on the FCD-E1 LCD and control terminal, and lists the actions required to correct the alarm condition.

Table 6-3. FCD-E1 Alarm Messages

Terminal Message	LCD Message	Alarm Number	Description	Corrective Actions	Severity	Type
AIS LOCAL SYNC LOSS	**AIS L S LOSS: X**	24	Local loss of frame synchronization alarm on the specified link, caused by AIS condition	Problem at the equipment connected to the remote end of the link	MAJOR	ON/OFF
AIS OCCURED	**AIS OCCURRED: X**	23	AIS is being detected on the link	Problem at the equipment connected to the remote end of the link	MAJOR	ON/OFF
ALARM BUFFER OVERFLOW	**ALM BUFFER OVF**	04	More than 100 alarms entries have been written in the alarm buffer since the last clear command	Read the messages, and then send the CLR ALM /A (CA) command from the supervision terminal	MINOR	ON
BPV ERROR	**BPV ERROR: X**	30	Bipolar violations in the main or sublink receive signal. Updated once per second	Have the corresponding link checked. Perform the power-up self-test and replace the FCD-E1 if a failure is detected	MINOR	ON
BRG FAILURE	**B.R.G FAIL: X**	33	FCD-E1 technical failure (baud rate generator of the specified user channel failed)	Replace the FCD-E1	MAJOR	ON/OFF
CLOCK WAS CHANGED TO FALLBACK	**FALLBACK CLK USE**	07	FCD-E1 switched to the fallback clock source, because the master clock source failed	Check the master clock source. A clock source is replaced as a result of failure under the following conditions: 1. ML - fails during local loss of frame synchronization on the main link 2. CH1 or CH2 - fails when the data channel equipment is disconnected or inoperative (DTR line not asserted) 3. SL - fails when the local sub loses frame synchronization	MINOR	ON
CLOCK WAS CHANGED TO INTERNAL	**INTERNAL CLK USE**	08	FCD-E1 switched to the internal clock source, because both the master and the fallback clock sources failed	1. Check the two clock sources. 2. Perform the power-up self-test and replace the FCD-E1 if a failure is detected	MINOR	ON

Table 6-3. FCD-E1 Alarm Messages (Cont.)

Terminal Message	LCD Message	Alarm Number	Description	Corrective Actions	Severity	Type
CLOCK WAS CHANGED TO MASTER	**CLK CHANG TO MST**	09	The FCD-E1 switched back to the clock source selected as the master source	Normal state - no action required	MINOR	ON
CRC-4 ERROR	**CRC ERROR: X**	32	CRC-4 errors detected in the main or sublink receive signal. Updated once per second	1. Have the link checked. 2. Perform the power-up self-test and replace the FCD-E1 if a failure is detected	MINOR	ON
DATABASE CHECKSUM ERROR	**DB CHKSUM ERR**	11	FCD-E1 technical failure (the database currently stored in the non-volatile memory of FCD-E1 is corrupted)	1. Use the supervision terminal to enter the INIT DB command. 2. Turn the FCD-E1 off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Rplace the FCD-E1 if a failure is detected	MAJOR	ON/OFF
DB SWITCH IS ON	**DB DW IS ON**	06	The DB section 3 of DIP switch S1 is set to ON (the changes made to the database will be lost if the unit is turned off or reset).	1. Remove FCD-E1 cover. 2. Set section 3 on DIP switch S1 to OFF.	MINOR	ON
DP ALTERNATE CALL FAILED	**DP ALT CALL FAIL**	16	The call attempts to the alternate dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DTE connector. If the called number is often busy, you may also increase the number of call retries	MAJOR	ON
DP DIAL CYCLE FAILED	**DIAL CYCLE FAIL**	10	The current cycle of call attempts failed	Check the modem connected to the CONTROL DTE connector. If the called numbers are often busy, you may also increase the number of call retries	MAJOR	ON
DP PRIMARY CALL FAILED	**DP PRM CALL FAIL**	15	The call attempts to the primary dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DTE connector. If the called number is often busy, you may also increase the number of call retries	MAJOR	ON

Table 6-3. FCD-E1 Alarm Messages (Cont.)

Terminal Message	LCD Message	Alarm Number	Description	Corrective Actions	Severity	Type
DRIVER FAILURE	**DRIVER FAIL: X**	20	FCD-E1 technical failure (main or sublink line driver)	1. Check the transmit line pair 2. Replace the FCD-E1	MAJOR	ON/OFF
DUPLICATE NAME IN THE NETWORK	**DUPLIC NET NAME**	38	Another node in the network uses the FCD-E1 logical name. This prevents SNMP management	Check and change as required	MAJOR	ON/OFF
EXECIVE BPV	**EXECIVE BPV: X**	22	The rate of bipolar violations in the main or sublink receive signal exceeds 1×10^{-6} during a measurement interval of 1000 seconds	1. Problem in the network facilities used by the corresponding link. 2. Turn the FCD-E1 off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Rplace the FCD-E1 if a failure is detected	MAJOR	ON/OFF
EXECIVE ERR RATIO	**EXE ERR RAT: X**	31	The bit error rate of the link receive signal exceeds 1×10^{-3}	1. Problem in the network facilities used by the corresponding link. 2. Turn the FCD-E1 off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1 if a failure is detected	MAJOR	ON/OFF
FRAME SLIP	**FRAME SLIP: X**	29	E1 frame slips are detected (not displayed during local loss of frame synchronization). Updated once per second	1. Incorrect selection of master clock source 2. Problem at far end (unstable clock source) 3. Replace the FCD-E1 only if steps 1 and 2 do not correct the problem.	MAJOR	ON
HARDWARE FAILURE	**HARDWARE FAILURE**	05	FCD-E1 technical failure (one of the internal programmable components)	Replace the FCD-E1	MAJOR	ON/OFF
LINK INTEGRITY ERROR	**INTGRITY ERR: X**	42	The Ethernet interface is not connected to an operating LAN	Check the cable connecting the LAN, the LAN media, and check that at least one station is active on the LAN	MAJOR	ON/OFF

Table 6-3. FCD-E1 Alarm Messages (Cont.)

Terminal Message	LCD Message	Alarm Number	Description	Corrective Actions	Severity	Type
LOCAL MF ALARM	**L MF ALARM: X**	26	Local loss of multiframe synchronization alarm on the specified link	1. Check that the correct framing mode is used at the local and remote ends. 2. Perform the corrective actions listed for LOCAL SYNC LOSS.	MAJOR	ON/OFF
LOCAL SYNC LOSS	**L SYNC LOSS: X**	25	Local loss of frame synchronization alarm on the specified link	1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote FCD-E1 3. Replace the FCD-E1	MAJOR	ON/OFF
LOOP INBAND ON	**LP INBAND ON: X**	35	An inband activated loopback is now connected on a data channel	If the loopback is no longer needed, disconnect it	MAJOR	ON
MANAGEMENT PORT IS DOWN	**MNGT P DOWN: X**	37	The FCD-E1 cannot communicate with the network management station. This may indicate incorrect set-up of the management port parameters, a problem on the communication path, or a hardware failure	1. Correct the parameters. 2. Check for disconnection. 3. Check for hardware failure. 4. Check the management communication path	MAJOR	ON/OFF
MANAGEMENT PORT IS LOOPED	**MNGT P LOOP: X**	36	The management port receives its own messages (this could be caused by a test loopback on the communication path used for SNMP management or on the management port). Management is not possible while this condition is present	Find the location of the loopback and request disconnection	MAJOR	ON/OFF
PC-SP SWITCH IS ON	**PC-SP DW IS ON**	14	Section PC/SP of switch S2 is set to ON	Set the switch to OFF	MINOR	ON
PSWRD SWITCH IS ON	**PSWRD DW IS ON**	12	Section PSWD of switch S2 is set to ON	If it is no longer necessary to enforce the default password and node number, return the switch to OFF	MINOR	ON
REAL TIME CLOCK BATTERY FAILURE	**RTC BATTERY FAIL**	01	The internal battery that powers the FCD-E1 internal real-time clock while the FCD-E1 is not powered has failed	Have the FCD-E1 repaired	MAJOR	ON

Table 6-3. FCD-E1 Alarm Messages (Cont.)

Terminal Message	LCD Message	Alarm Number	Description	Corrective Actions	Severity	Type
REMOTE MF ALARM	**R MF ALARM: X**	27	Remote loss of multiframe synchronization alarm on the specified link	Problem at the remote equipment	MAJOR	ON/OFF
REMOTE SYNC LOSS	**R SYNC LOSS: X**	28	Remote loss of frame synchronization alarm on the specified link	Problem at the remote equipment. Perform the following checks on the remote equipment: 1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote equipment. 3. Replace the equipment	MAJOR	ON/OFF
RTS/CONTROL IS OFF	**RTS/CONTROL OFF**	43	Indicates that the RTS at the DTE is off.	Set the RTS at the DTE to the ON state.	MAJOR	ON/OFF
SELF TEST ERROR	**SELF TEST ERROR**	17	A problem has been detected during FCD-E1 self-test	Replace the FCD-E1	MAJOR	ON/OFF
SFIFO SLIP	**SFIFO SLIP: X**	34	Technical problem (FIFO overflow/underflow), usually caused by differences in clock rates	1. Check the clock mode of the corresponding channel. 2. Turn the FCD-E1 off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1 if a failure is detected	MAJOR	ON
SIGNAL LOSS	**SIGNAL LOSS**	21	Loss of main or sublink receive signal	1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote unit. 3. Perform the power-up self-test and replace the FCD-E1 if a failure is detected	MAJOR	ON/OFF
SP-PAR SWITCH IS ON	**SP-PAR DW IS ON**	13	Section DEF PAR of internal DIP switch S1 is set to ON	If this setting is no longer required, return the switch section to OFF	MINOR	ON

Working with Alarm Buffer

You can manage the alarm buffer either from the control terminal, or from the LCD.

From the Control Terminal

You can display the active alarms from the supervisory terminal.

➤ **To display the active alarms:**

- Type **`DSP ALM`**.

The terminal displays up to 100 alarms stored in the buffer, listing for each alarm its number, alarm itself, its state (ON or OFF) and the time when the last change in its state occurred.

➤ **To clear the alarm buffer:**

- Type **`CLR ALM`** or **`CLR ALM/A`** or **`DSP ALM/CA`**.

For more details, see description of the corresponding command in *Appendix D*.

From the LCD

You can view the ON-state alarms stored in the alarm buffer, on the front panel LCD display, and delete the alarm messages from the buffer when no longer needed. This procedure is explained below.

When the top row shows ALARM BUFFER, the second row displays the following information:

- During normal operation, the second row shows EMPTY (no alarm messages)
- If the alarm buffer contains ON-state alarms, the LCD shows SCROLL in the left-hand field of the second row, and CLEAR in the right-hand field.

➤ **To display the alarms:**

1. Bring the cursor to SCROLL.
2. Press ENTER.

Now you can scroll between the ON-state alarms stored in the alarm buffer. To interpret the alarm messages displayed in the second row, refer to *Table 6-3*.

To correct the reported problem, perform the corrective actions in the given order, until the problem is resolved.

➤ **To delete the alarms:**

1. Display ALARM BUFFER in the first row.
2. Bring the cursor in the second row to CLEAR.
3. Press ENTER to clear the ON-type alarms and the alarm history in the buffer. If no ON-state alarms are present, the second row should show EMPTY.

6.4 Troubleshooting

In case a problem occurs, check the displayed alarm messages as described in *Table 6-3*. If the problem cannot be corrected by performing the actions listed in *Table 6-3*, use *Table 6-4* to identify the trouble symptoms. Perform the actions listed under "Corrective Measures" in the order given, until the problem is corrected.

Table 6-4. Troubleshooting Chart

Nº	Trouble Symptoms	Probable Cause	Corrective Measures
1	The FCD-E1 is "dead"	1. No power	Check that both ends of the power cable are connected properly.
		2. Blown fuse (AC powered FCD-E1 only)	Disconnect the AC power cable from both ends and replace with fuse of proper rating.
		3. Defective FCD-E1	Replace the FCD-E1.
2	Local FCD-E1 reports local main link sync loss	1. External problem	Activate the local analog loopback on the main link. Check that the local FCD-E1 MAIN LOC SYNC LOSS indicator turns OFF. If the indicator is OFF, the problem is external.
		2. Defective FCD-E1	Perform power-up self-test and replace the FCD-E1 if defective.
3	Local FCD-E1 reports local sublink sync loss	1. External problem	Activate the remote analog loopback on the sublink. Check that the local FCD-E1 SL LOC SYNC LOSS indicator is OFF. If the indicator is OFF, the problem is external.
		2. Defective FCD-E1	Perform power-up self-test and replace the FCD-E1 if defective.
4	Local user connected to one of the FCD-E1 channels cannot communicate with the remote equipment (main link operates normally)	1. External problem	Activate the local digital loopback on that channel. Check that the equipment connected to the channel receives its own signal. If not, the problem is external.
		2. Defective FCD-E1	Perform power-up self-test and replace the FCD-E1 if defective.
5	Ethernet interface ERR indicator lights most of the time, and LAN cannot operate	1. Loopback connected on the FCD-E1 with Ethernet interface	If the TST indicator lights, check and disconnect the loopback
		2. Cable problem	Check and replace if necessary the cable that connects the 10BaseT connector to the LAN
		3. Problem on the LAN	Disconnect the FCD-E1 from the LAN: if problem persists, troubleshoot the LAN
		4. Defective FCD-E1	Perform power-up self-test and replace the FCD-E1 if defective

Table 6-4. Troubleshooting Chart (Cont.)

Nº	Trouble Symptoms	Probable Cause	Corrective Measures
6	Ethernet interface LINK indicator not lit	1. No active station on the LAN	Check that at least one station is active on the LAN
		2. Cable problem	Check and replace if necessary the cable that connects the 10BaseT connector to the LAN
		3. Problem on the LAN	Check LAN media
		4. Defective FCD-E1	Perform power-up self-test and replace the FCD-E1 if defective

6.5 Testing FCD-E1

The user-controlled test functions of FCD-E1 consist of diagnostic loopback tests. You can run the tests from either the front panel or a control terminal. The purpose of these loopback tests is to determine the source of a break in the data flow. By checking a variety of data paths, a series of loopback tests can pinpoint the source of the obstruction of data.

This section provides general instructions for running the tests, followed by a description of each test. The test descriptions include the terminal commands and LCD designations for each test.

Before executing a test, pay attention to the following:

- You should activate only one loopback at a time. However, FCD-E1 allows you to activate a remote loopback on one link, and a local loopback on the other link.
- If a loopback is already connected, the TEST indicator lights.
- If you try to connect a loopback while another loopback of the same type is already connected, FCD-E1 displays an error message.

Operating Loopbacks from the Front Panel

For general instructions on using the FCD-E1 front panel, refer to *Chapter 3*.

➤ **To activate or deactivate a specific test from the front panel:**

1. Bring the cursor to the left-hand field in the top row (if it is not already there).
2. Scroll to display TEST OPTION in the top row; the right-hand field of the top row indicates ML, meaning that the displayed loopback state pertains to the main link. Second row shows the loopback type and its current state: ON or OFF.
3. To change the link, bring the cursor to the right-hand field in the top row, and scroll to display SL; the right-hand field of the top row indicates SL, meaning that the displayed loopback state pertains to the sublink. Second row shows the loopback type and its current state: ON or OFF.

4. Repeat step 3 to change the link and display CH1, meaning that the displayed loopback state pertains to data channel 1. Second row shows the loopback type and its current state: ON or OFF.
5. Repeat step 3 to change the link and display CH2, meaning that the displayed loopback state pertains to data channel 2. Second row shows the loopback type and its current state: ON or OFF.
6. After you selected the desired link, bring the cursor to the left-hand field in the second row, and scroll to display the desired type of loopback: LOCAL LOOP or REMOTE LOOP (for ML and SL), LOCAL LOOP, REMOTE LOOP, BERT or INBAND LOOP (for CH1 and CH2). The right-hand field shows the current state of the selected loopback: ON or OFF.
7. To change the test state, bring the cursor to the right-hand field in the second row, and scroll to display the desired state (ON or OFF); the second row shows the new state of the selected test (for instance, ON).
8. Press ENTER to activate or deactivate the displayed test; the TEST indicator lights if the test is activated, or goes off if no tests are active.

Operating Loopbacks from a Control Terminal

The diagnostic loops can be activated from a control terminal by entering the following commands:

LP LOC ANA ML	LP REM ANA ML	LP LOC DIG ML	LP REM DIG ML
LP LOC ANA SL	LP REM ANA SL	LP LOC DIG SL	LP REM DIG SL
LP LOC CH1	LP LOC CH2	LP REM CH1	LP REM CH2
LP INBAND CH1	LP INBAND CH2	LP BERT CH1	LP BERT CH2

For general instructions on entering FCD-E1 commands from a control terminal, refer to *Chapter 4*.

User-Controlled Loopback Tests

The test and loopback functions are described in the following paragraphs. The test functions are identified by the command used to activate the corresponding test/loopback function. The figures illustrating the signal paths for each loopback type show the FCD-E1 version equipped with the sublink.

No channel loopbacks are available for the Ethernet interface. In addition, main link loopbacks should not be activated on an FCD-E1 with Ethernet interface while the Ethernet interface is connected to the LAN. This would cause a state of permanent collision on the LAN (this would prevent other users from using the LAN as long as the loopback is connected).

Main Link Local Analog Loopback (LP LOC ANA ML)

This loopback is performed by connecting the main link transmit signal to the input of the receive path, as shown in *Figure 6-1*. This returns the transmit signal of each port (channel and sublink) on the receive path of the same port. The test signal is provided by the equipment connected to the local ports: each one must receive its own transmission.

Note *Before connecting this loopback on an FCD-E1 with an Ethernet port, disconnect the LAN cable from the rear panel Ethernet interface.*

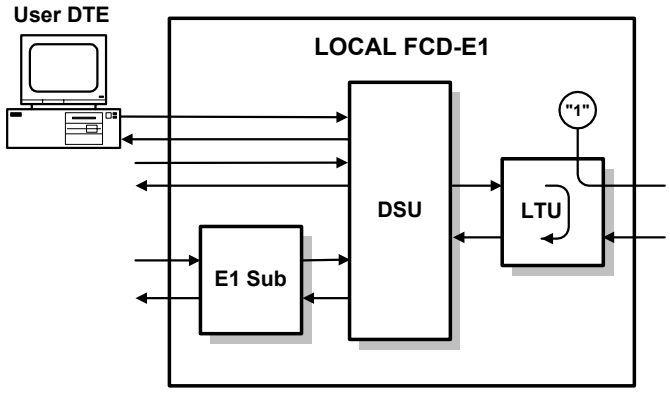


Figure 6-1. Main Link Local Analog Loopback

This test fully checks local FCD-E1 operation, and the connections to the local DTE.

During the loopback, the local FCD-E1 sends an unframed “all-ones” signal to the remote FCD-E1.

Note *When the sublink CGA mode is TRANS or NONE, and a sub local sync loss alarm condition is present, the sublink sends an OOS pattern in the assigned main link timeslots (for NONE it also sends the OOS SIGNAL pattern).*
Under these conditions, it is not possible to perform BER testing on the sublink when the local analog loopback is connected: if you try to measure the BER, the result is invariably errors.

Main Link Remote Analog Loopback (LP REM ANA ML)

Locally performed analog loopback towards the remote equipment. Performed by connecting at the local FCD-E1 the regenerated receive signal to the transmit input of the main link interface, as shown in *Figure 6-2*. The test signal is provided by the user's equipment connected to the ports of the remote FCD-E1: each one must receive its own transmission.

This test checks the connections to the remote DTE, all the circuits of the remote FCD-E1, the main link interface functions of the remote and local FCD-E1, and the transmission plant connecting the two FCD-E1.

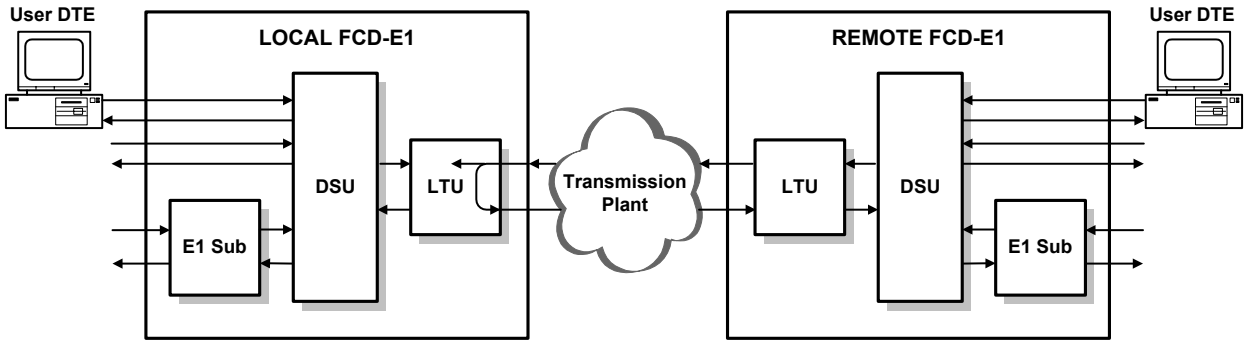


Figure 6-2. Main Link Remote Analog Loopback

Main Link Local Digital Loopback (LP LOC DIG ML)

This loopback is performed by connecting the E1 digital transmit signal of the main link to the input of the receive path, without passing through the main link interface. Signal paths are shown in *Figure 6-3*.

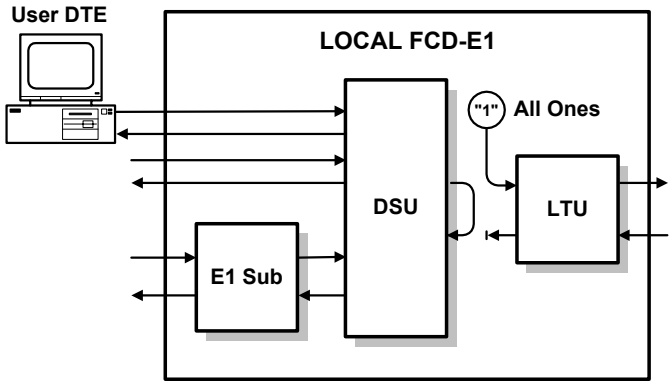


Figure 6-3. Main Link Local Digital Loopback

Note

Before connecting this loopback on an FCD-E1 with an Ethernet port, disconnect the LAN cable from the rear panel Ethernet interface.

The test signal is provided by the equipment connected to the local ports: each one must receive its own transmission. The NOTE regarding BER testing on the sublink when the local analog loopback is active also applies to the local digital loopback.

This test checks the digital circuits of the local FCD-E1 (DSU section.), and the connections to the local user equipment.

Sublink Local Analog Loopback (LP LOC ANA SL)

Local analog loopback towards the local sublink. Performed by connecting the sublink transmit signal to the input of the sub receive path, as shown in *Figure 6-4*. The test signal is provided by the equipment connected to the local sublink, that must receive its own transmission.

This test fully checks the connections to the equipment connected to the local sublink.

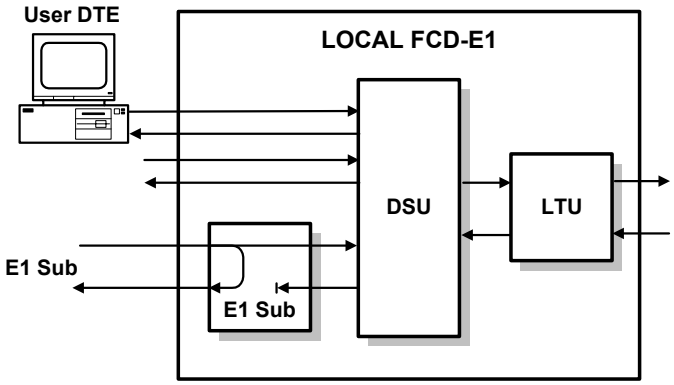


Figure 6-4. Sublink Local Analog Loopback

Sublink Remote Analog Loopback (LP REM ANA SL)

Local analog loopback towards the remote sublink. Performed by connecting the sublink transmit signal to the input of the sub receive path within the sub line interface circuits, as shown in *Figure 6-5*. The test signal is provided by the equipment connected to the remote sublink, that must receive its own transmission. During the loopback, the local FCD-E1 sends an unframed “all-ones” signal to the equipment connected to the local sublink.

This test checks the connections to the equipment connected to the remote sublink, all the circuits of the remote FCD-E1, the functions of the remote and local FCD-E1, and the transmission plant connecting the two FCD-E1.

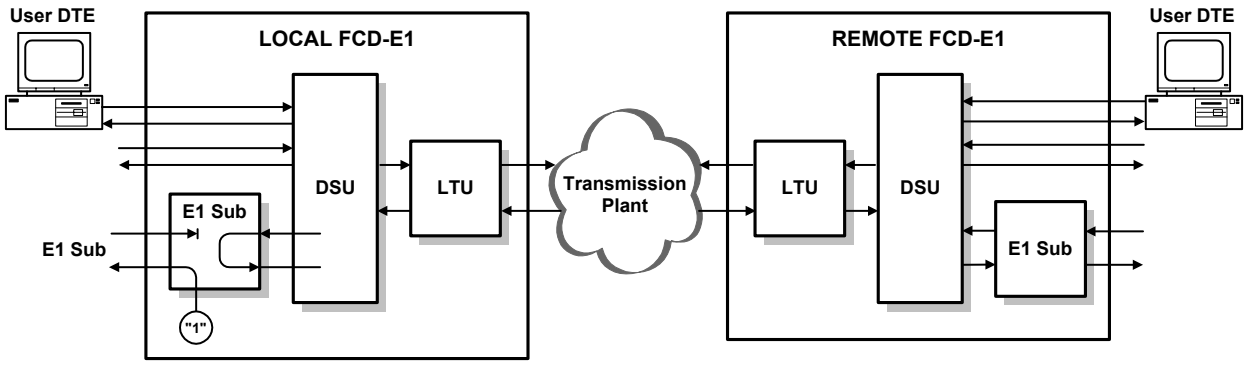


Figure 6-5. Sublink Remote Analog Loopback

Sublink Remote Digital Loopback (LP REM DIG SL)

Remote digital loopback towards the remote sublink. Performed by connecting the sublink transmit signal to the input of the sub receive path within the sub framer circuits (before the transmit signal is applied to the line interface circuits). Except for the location of the loopback, signal path is similar to that shown in *Figure 6-5*. This test checks the same functions as the sublink remote analog loopback, except that it does not check the operation of the analog sub-line interface.

Channel Local Loopback (LP LOC CH)

Local digital loopback towards the local user DTE connected to the channel on which the loopback is connected. Performed by connecting the data channel transmit signal to the input of the receive path, as shown in *Figure 6-6*. The test signal is provided by the local DTE, which must receive its own transmission. This test mainly checks the connections to the local DTE.

Note

When an alarm condition is present on the main link, the receive data is held at MARK. Under these conditions, it is not possible to perform BER measurements when a local channel loopback is connected. If you try to measure BER, the result is invariably errors.

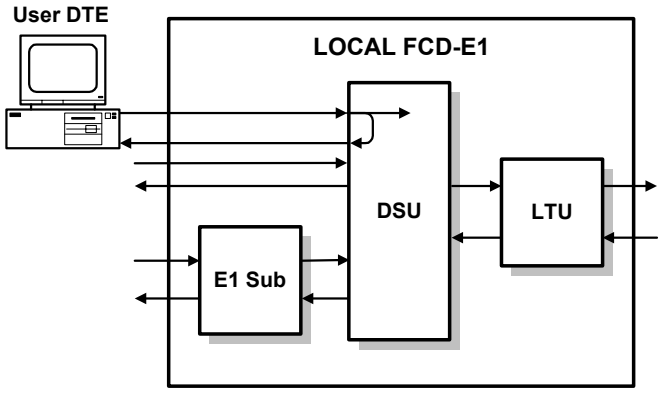


Figure 6-6. Channel Local Loopback

Channel Remote Loopback (LP REM CH)

Local digital loopback towards the remote user's DTE connected to the channel on which the loopback is connected. Performed by connecting the local data channel receive signal to the data channel transmit input, as shown in *Figure 6-7*. The test signal is provided by the remote user DTE, that must receive its own transmission.

This test fully checks the user data link, including the cables connecting the remote DTE to the FCD-E1, the remote FCD-E1, the transmission plant connecting the two FCD-E1 and the local FCD-E1.

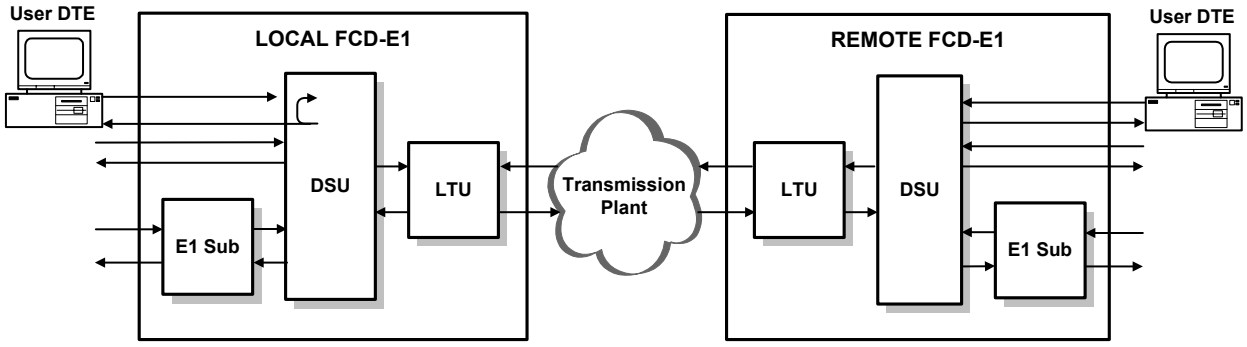


Figure 6-7. Channel Remote Loopback

Channel Inband Loopback (LP INBAND CH)

FCD-E1 supports both reception and transmission of the inband-activated loopback, in accordance with the ANSI FT1/FE1 RDL (T1E1.2/93-003).

The inband-activated channel loopback can be performed using two sites, Site A (transmitter) and Site B (reciever), and is similar to the data channel remote loopback, except that it is performed on the Site B FCD-E1, in response to a command entered at the Site A FCD-E1. The loopback is performed towards the Site A local user's equipment connected to the data channel.

The remote loopback is activated and deactivated by transmitting special sequences for approximately 2 seconds from Site A unit causing it to enter the TX INBAND state.

When an inband loopback pattern is sent by the Site A equipment (connected to the main link of the Site B unit), and the Site B equipment BERT detects this pattern for approximately 2 seconds, a remote loop is initiated on the data channel of the Site B unit, causing it to enter the RX INBAND state. Once the remote data channel loopback is on, the Site B unit BERT tries to match loop deactivation series.

Note *To enable the activation of a remote loopback in response to the reception of the inband loopback command from the remote system you must activate the DEF BERT CH command and set the RX_INBAND parameter to ENABLE.*

BER Testing (LP BERT CH)

BER testing can be performed on one channel at a time. To perform the test over the whole link, end-to-end, use the inband activated loopback; for a local test, use one of the local main link loopbacks, or any other loopback that returns the data towards the local DTE, must be activated.

During the test, the local DTE is disconnected and the DSR line is off; an internal pattern generator connects a user-selected test sequence to the transmit input of the local data channel interface. To calibrate the system, the user can inject errors at a selectable rate.

The receive output is connected to a pattern evaluator. The evaluator compares the received and transmitted patterns and detects errors. The test results are presented as follows:

- On the supervision terminal, detailed full data is displayed, including information on factors such as the number of seconds during which the FCD-E1 lost frame synchronization (*see the DSP BERT command in Appendix D*).
- On the LCD, the result appears as GOOD (no errors) or BAD (at least one error has been detected during the BER measurement interval).

6.6 Frequently Asked Questions

Question: Is it possible to split the bandwidth while working in unframed mode?

Answer: No, when you work in unframed mode, it is impossible to split the bandwidth to more than one user. The E1 port transparently transfers the incoming data stream on a bit-by-bit basis. This allows the transfer of Unframed 2048 kbps data streams.

Question: Which management platform should I use in order to mange FCD-E1?

Answer: In order to mange FCD-E1 you should use RADview TDM over HPOV and a Solaris platform.

Question: What is the sequence of commands necessary for configuring FCD-E1/T1 in the DTE-2 clock mode?

Answer: In order to configure the FCD-E1/T1 in the DTE2 clock mode, you must first define clock mode = DTE2. Use the command 'DEF CH 1' or 'DEF CH 2 (depending on which channel you want to configure as clock source).
Then you can configure with 'DEF SYS' Master Clock = CH1 or Master Clock = CH2.

Question: Is there any MTU size (Maximum Transmission Unit) limitation if I have a Cisco router and want to use inband management on one of the above products by using a dedicated Frame Relay or PPP protocol?

Answer: Yes, the 'Maximum Transmission Unit' must be configured to 200.

Question: What are the software upgrade options for FCD-E1?

Answer: FCD-E1 with software version 0.30 and above can be upgraded to version 1.00. The ordering option is: FCD-E1/EPROM/1.00.
Software version 0.2x can be upgraded up to version 0.23. The ordering option is: FCD-E1/EPROM/0.23.
Software version 0.1x must be checked separately for compatibility with version software 0.23.

6.7 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide.

Appendix A
Pinouts

A.1 E1 Port Connectors

The unbalanced interface of each E1 port is terminated in two BNC connectors:

- The connectors of the main link port are designated RX-IN and TX-OUT.
- The connectors of the sublink port are designated RX-OUT and TX-IN.

The balanced interface of each port is terminated in an eight-pin RJ-45 connector, wired in accordance with *Table A-1*.

Table A-1. MAIN E1 and SUB E1 Port Connectors, Pin Allocation

Pin	Designation	Direction		Function
		MAIN E1 Port	SUB E1 Port	
1	RD(T)	Input	Output	Receive data (tip)
2	RD(R)	Input	Output	Receive data (ring)
3	FG	↔	↔	Frame ground
4	TD(T)	Output	Input	Transmit data (tip)
5	TD(R)	Output	Input	Transmit data (ring)
6	FG	↔	↔	Frame ground
7, 8	N/A	N/A	N/A	Not connected

A.2 Data Channel Connector

The data channels of the FCD-E1/1 and FCD-E1/2 are terminated in a 25-pin D-type female connector, irrespective of the channel interface type. The pin allocation in the data channel connector is given in *Table A-2*.

Table A-2. Data Channel Connector Pin Allocation

Pin	Direction	Designation	Function	RS-530 Circuit
1	↔	FG	Frame Ground	AA
2	Input	SDA	Send Data (wire A)	BA(A)
3	Output	RDA	Receive Data (wire A)	BB(A)
4	Input	RTSA	RTS (wire A)	CA(A)
5	Output	CTSA	CTS (wire A)	CB(A)
6	Output	DSRA	DSR (wire A)	CC(A)
7	↔	SG	Signal Ground	AB
8	Output	DCDA	DCD (wire A)	CF(A)
9	Output	RCB	Receive Clock (wire B)	DD(B)
10	Output	DCDB	DCD (wire B)	CF(B)
11	Input	SCEB	External Send Clock (wire B)	DA(B)
12	Output	SCB	Send Clock (wire B)	DB(B)
13	Output	CTSB	CTS (wire B)	CB(B)
14	Input	SDB	Send Data (wire B)	BA(B)
15	Output	SCA	Send Clock (wire A)	DB(A)
16	Output	RDB	Receive Data (wire B)	BB(B)
17	Output	RCA	Receive Clock (wire A)	DD(A)
18	Input	LLBA	Local loopback activation (wire A)	–
19	Input	RTSB	RTS (wire B)	CA(B)
20	Input	DTRA/RCEA	DTRA/External Receive Clock (wire A)	CD(A)
21	Input	RLBA	Remote loopback activation (wire A)	–
22	Output	DSRB	DSR (wire B)	CC(B)
23	Input	DTRB/RCEB	DTRB/External Receive Clock (wire B)	CD(B)
24	Input	SCEA	External Send Clock (wire A)	DA(A)
25	Output	TMA	Test mode indication (wire A)	–

RS-530 Data Channel

The functions of the pins in the RS-530 data channel interface connector are listed in *Table A-2*. The following sections provide information on the cables required to connect user's equipment to the RS-530 channel in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with DTE interface. The user's equipment can be directly connected to the FCD-E1 channel connector using a standard "straight" RS-530 cable (i.e., a cable wired point-to-point). The "straight" cable is terminated in a 25-pin male D-type connector at the FCD-E1 side.

DTE1 Mode

This mode is used to connect to user's equipment with DCE interface that can accept, as its external clock, the receive clock signal provided by the FCD-E1 data channel.

In this case, it is necessary to connect a 25-pin male/25-pin male cross-cable (see *Figure A-1*) wired in accordance with *Table A-3*, between the FCD-E1 CHANNEL connector and the user's equipment RS-530 connector.

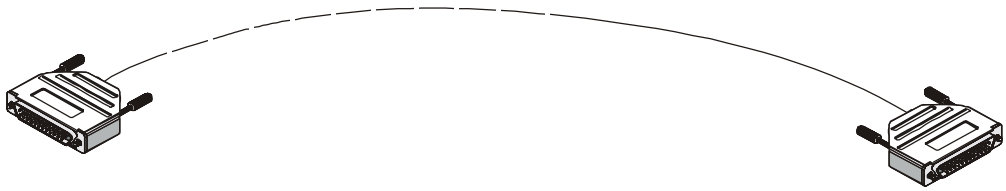


Figure A-1. RS-530 Adapter Cable for DTE1 Mode

Table A-3. Wiring of RS-530 Adapter Cable for DTE1 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	3
3	RDA	Receive Data (wire A)	2
4	RTSA	RTS (wire A)	8
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	20
7	SG	Signal Ground	7
8	DCDA	DCD (wire A)	4
9	RCB	Receive Clock (wire B)	11
10	DCDB	DCD (wire B)	19
11	SCEB	External Send Clock (wire B)	9

Table A-3. Wiring of RS-530 Adapter Cable for DTE1 Mode (Cont.)

FCD-E1 Side	Designation	Function	User's Side
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	16
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	14
17	RCA	Receive Clock (wire A)	24
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	23
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with DCE interface that provides the transmit and receive clocks to the FCD-E1 data channel.

In this case, it is necessary to connect a 25-pin male/25-pin male cross-cable (see *Figure A-1*) wired in accordance with *Table A-4*, between the FCD-E1 CHANNEL connector and the user's equipment RS-530 connector.

Table A-4. Wiring of RS-530 Adapter Cable for DTE2 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	3
3	RDA	Receive Data (wire A)	2
4	RTSA	RTS (wire A)	8
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	20
7	SG	Signal Ground	7
8	DCDA	DCD (wire A)	4
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	19
11	SCEB	External Send Clock (wire B)	9

Table A-4. Wiring of RS-530 Adapter Cable for DTE2 Mode (Cont.)

FCD-E1 Side	Designation	Function	User's Side
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	16
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	14
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	15
21	–	Not connected	–
22	DSRB	DSR (wire B)	23
23	RCEB	External Receive Clock (wire B)	12
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

V.35 Data Channel

The following sections provide information on the cables required to connect user's equipment to the V.35 channel in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with V.35 DTE interface. The V.35 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-2*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2/V/1, is available from RAD.

Cable wiring is given in *Table A-5*.

Figure A-2. V.35 Adapter Cable for DCE Mode

Table A-5. Wiring of V.35 Adapter Cable for DCE Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	P
3	RDA	Receive Data (wire A)	R
4	RTSA	RTS (wire A)	C
5	CTSA	CTS (wire A)	D
6	DSRA	DSR (wire A)	E
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	F
9	RCB	Receive Clock (wire B)	X
10	DCDB	DCD (wire B)	–
11	SCEB	External Send Clock (wire B)	W
12	SCB	Send Clock (wire B)	AA
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	S
15	SCA	Send Clock (wire A)	Y
16	RDB	Receive Data (wire B)	T
17	RCA	Receive Clock (wire A)	V
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	U
25	–	Not connected	–

DTE1 Mode

This mode is used to connect to user's equipment with V.35 DCE interface that can accept, as its external clock, the receive clock signal provided by the FCD-E1 data channel.

The V.35 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-2*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2/V/2, is available from RAD.

Cable wiring is given in *Table A-6*.

Table A-6. Wiring of V.35 Adapter Cable for DTE1 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	R
3	RDA	Receive Data (wire A)	P
4	RTSA	RTS (wire A)	F
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	H
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	C
9	RCB	Receive Clock (wire B)	W
10	DCDB	DCD (wire B)	–
11	SCEB	External Send Clock (wire B)	X
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	T
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	S
17	RCA	Receive Clock (wire A)	U
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	V
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with V.35 DCE interface that provides the transmit and receive clocks to the FCD-E1 data channel.

The V.35 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-2*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2/V/3, is available from RAD.

Cable wiring is given in *Table A-7*.

Table A-7. Wiring of V.35 Adapter Cable for DTE2 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	R
3	RDA	Receive Data (wire A)	P
4	RTSA	RTS (wire A)	F
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	H
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	C
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	–
11	SCEB	External Send Clock (wire B)	X
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	T
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	S
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	Y
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	AA
24	SCEA	External Send Clock (wire A)	V
25	–	Not connected	–

X.21 Data Channel

The following sections provide information on the cables required to connect user's equipment to the X.21 channel in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with X.21 DTE interface. The X.21 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-3*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 15-pin female connector at the user's side. A suitable cable, designated CBL-HS2/X/1, is available from RAD.

Cable wiring is given in *Table A-8*.

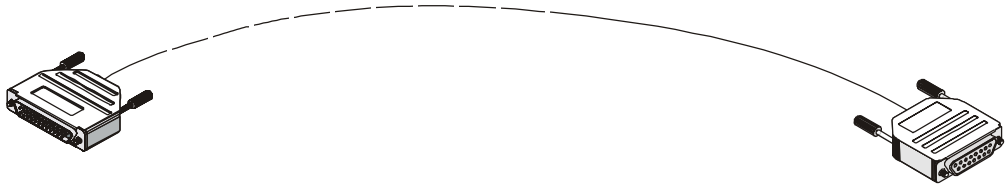


Figure A-3. X.21 Adapter Cable for DCE Mode

Table A-8. Wiring of X.21 Adapter Cable for DCE Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	2
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	3
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	–
7	SG	Signal Ground	8
8	DCDA	DCD (wire A)	5
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	12
11	SCEB	External Send Clock (wire B)	–
12	SCB	Send Clock (wire B)	13
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	9
15	SCA	Send Clock (wire A)	6

Table A-8. Wiring of X.21 Adapter Cable for DCE Mode (Cont.)

FCD-E1 Side	Designation	Function	User's Side
16	RDB	Receive Data (wire B)	11
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	–
25	–	Not connected	–

V.36/RS-449 Data Channel

The following sections provide information on the cables required to connect user's equipment to the V.36/RS-449 channel in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with V.36/RS-449 DTE interface. The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-4*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2/R/1, is available from RAD.

Cable wiring is given in *Table A-9*.

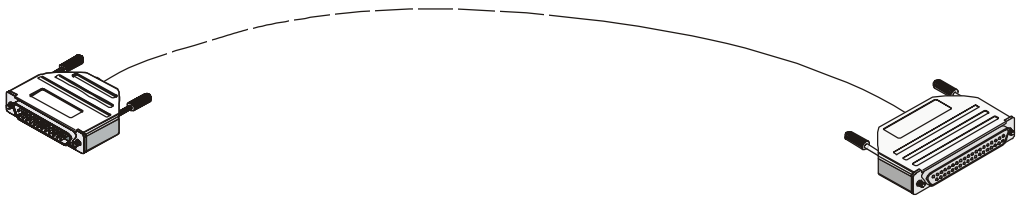


Figure A-4. V.36/RS-449 Adapter Cable for DCE Mode

Table A-9. Wiring of V.36/RS-449 Adapter Cable for DCE Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	4
3	RDA	Receive Data (wire A)	6
4	RTSA	RTS (wire A)	7
5	CTSA	CTS (wire A)	9
6	DSRA	DSR (wire A)	11
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	13
9	RCB	Receive Clock (wire B)	26
10	DCDB	DCD (wire B)	31
11	SCEB	External Send Clock (wire B)	35
12	SCB	Send Clock (wire B)	23
13	CTSB	CTS (wire B)	27
14	SDB	Send Data (wire B)	22
15	SCA	Send Clock (wire A)	5
16	RDB	Receive Data (wire B)	24
17	RCA	Receive Clock (wire A)	8
18	–	Not connected	–
19	RTSB	RTS (wire B)	25
20	RCEA	External Receive Clock (wire A)	
21	–	Not connected	–
22	DSRB	DSR (wire B)	29
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

DTE1 Mode

This mode is used to connect to user's equipment with V.36/RS-449 DCE interface that can accept, as its external clock, the receive clock signal provided by the FCD-E1 data channel.

The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-4*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2/R/2, is available from RAD.

Cable wiring is given in *Table A-10*.

Table A-10. Wiring of V.36/RS-449 Adapter Cable for DTE1 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	6
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	13
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	12
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	7
9	RCB	Receive Clock (wire B)	35
10	DCDB	DCD (wire B)	25
11	SCEB	External Send Clock (wire B)	26
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	24
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	22
17	RCA	Receive Clock (wire A)	17
18	–	Not connected	–
19	RTSB	RTS (wire B)	31
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	24
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	8
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with V.36/RS-449 DCE interface that provides the transmit and receive clocks to the FCD-E1 data channel.

The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1 CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-4*) is terminated in a 25-pin male D-type connector at the FCD-E1 side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2/R/3, is available from RAD.

Cable wiring is given in *Table A-11*.

Table A-11. Wiring of V.36/RS-449 Adapter Cable for DTE2 Mode

FCD-E1 Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	6
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	13
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	12
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	7
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	25
11	SCEB	External Send Clock (wire B)	26
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	24
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	22
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	31
20	RCEA	External Receive Clock (wire A)	5
21	–	Not connected	–
22	DSRB	DSR (wire B)	24
23	RCEB	External Receive Clock (wire B)	23
24	SCEA	External Send Clock (wire A)	8
25	–	Not connected	–

A.3 Supervisory Port Connectors

CONTROL DCE Connector

The CONTROL DCE supervisory port has a standard RS-232 DCE interface terminated in a 9-pin female connector, wired in accordance with *Table A-12*.

Table A-12. CONTROL DCE Supervisory Port, Pin Allocation

Pin	Function	Direction
1	Data Carrier Detect (DCD)	Output
2	Receive Data (RD)	Output
3	Transmit Data (TD)	Input
4	Data Terminal Ready (DTR)	Input
5	Signal Ground (SIG)	Common reference and DC power supply ground
6	Data Set Ready (DSR)	Output
7	Request to Send (RTS)	Input
8	Clear to Send (CTS)	Output
9	Ring Indication (RI)	Input

CONTROL DTE Connector

The CONTROL DTE supervisory port has a standard RS-232 DTE interface terminated in a 9-pin female connector, wired in accordance with *Table A-13*.

Some of the pins in the connector can be converted to serve as floating common alarm relay contacts. The *Alarm Relay Contacts* column lists the alternate use of these pins.

Table A-13. CONTROL DTE Supervisory Port, Pin Allocation

Pin	Function	Direction	Alarm Relay Contacts
1	Data Carrier Detect (DCD)	Input	Normally-closed (relative to pin 9)
2	Transmit Data (TD)	Input	-
3	Receive Data (RD)	Output	-
4	Data Terminal Ready (DTR)	Output	-
5	Signal Ground (SIG)	Common reference and DC power supply ground	-
6	Data Set Ready (DSR)	Input	-
7	Request to Send (RTS)	Output	-
8	Clear to Send (CTS)	Input	Normally-open (relative to pin 9)
9	Not used	Not applicable	Center contact

Appendix B
SNMP Management

B.1 Scope

This appendix provides the specific information required for the management of the FCD-E1 by means of the Simple Network Management Protocol (SNMP).

B.2 SNMP Environment

General

The SNMP management functions of the FCD-E1 are provided by an internal SNMP agent, which can use inband and out-of-band communication.

The SNMP management communication uses the User Datagram Protocol (UDP). UDP is a connectionless-mode transport protocol, part of the suite of protocols of the Internet Protocol (IP).

Note

Telnet management uses the TCP protocol over IP for management communication. After a Telnet session is started, the management interface is similar to that used for the supervision terminal (Configuration).

This section covers the information related to the SNMP environment. For a description of the IP environment, refer to section B.3.

SNMP Principles

The SNMP management protocol is an asynchronous command/response polling protocol. All the management traffic is initiated by the SNMP-based network management station, which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station (except for trap messages).

The managed entities include a function called an “SNMP agent”, which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly-formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

getRequest Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.

getNextRequest Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.

setRequest Command for manipulating specific management information within the managed entity. The managed entity responds with a **getResponse** message.

trap Management message carrying unsolicited information on extraordinary events (that is, events which occurred not in response to a management operation) reported by the managed entity.

The Management Information Base

The management information base (MIB) includes a collection of ***managed objects***. A managed object is defined as a parameter that can be managed, such as a performance statistics value.

The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes, types of equipment, etc.

An object's definition includes the range of values (also called “instances”) and the “access” rights:

Read-only Instances of that object can be read, but cannot be set.

Read-write Instances of that object can be read or set.

Write-only Instances of that object can be set, but cannot be read.

Not accessible Instances of that object cannot be read, nor set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree. A unique path reaches each “leaf” in the MIB therefore, by numbering the branching points, starting with the top, each leaf can be uniquely defined by a sequence of numbers. The formal description of the managed objects and the MIB structure is provided in a special standardized format, called Abstract Syntax Notation 1 (ASN.1).

Since the general collection of MIBs can also be organized in a similar structure, under the supervision of the Internet Activities Board (IAB), any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches), one of them being the experimental branch, and another the group of private (enterprise-specific) branch. Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIB'. Within this context, RAD has been assigned the enterprise number 164. Therefore, enterprise MIBs published by RAD can be found under 1.3.6.1.4.1.164.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, which is responsible for their contents.

MIBs Supported by the FCD-E1 SNMP Agent

The interpretation of the relevant MIBs is a function of the SNMP agent of each managed entity. The general MIBs supported by the FCD-E1 SNMP agent are as follows:

- RFC 1158 (standard MIB-II).
- RFC 1406 (standard E1/E1 MIB).

In addition, the FCD-E1 SNMP agent supports the RAD-private (enterprise-specific) MIB identified as (read the following as a continuous string):

```
iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).
rad(164).radGen(6).systems(1).radSysWAN(3).radFcdE1(30).
```

Enterprise-specific MIBs supported by RAD equipment, including those for the FCD-E1, are available in ASN.1 format from the RAD Technical Support Department.

Management Domains Under SNMP

SNMP enables, in principle, each management station that knows the MIB's supported by a device to perform all the management operations available on that device. However, this is not desirable in practical situations, so it is necessary to provide a means to delimit management domains.

SNMP Communities

To enable the delimitation of management domains, SNMP uses “communities”. Each community is identified by a name, which is an alphanumeric string of up to 255 characters defined by the user.

Any SNMP entity (this term includes both managed entities and management stations) is assigned by its user a community name. In parallel, the user defines for each SNMP entity a list of the communities which are authorized to communicate with it, and the access rights associated with each community (this is the SNMP community name table of the entity).

Access Restriction Using SNMP Communities

In general, SNMP agents support two types of access rights:

- **Read-only –** the SNMP agent accepts and processes only SNMP **getRequest** and **getNextRequest** commands from management stations which have a read-only community name.
- **Read-write –** the SNMP agent accepts and processes all the SNMP commands received from a management station with a read-write community name. SNMP agents are usually configured to send traps to management stations having read-write communities.

In accordance with the SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, first it checks the originator's community: messages with community names not included in the SNMP community names table of the recipient are discarded (SNMP agents of managed entities usually report this event by means of an authentication failure trap).

The SNMP agents of managed entities evaluate messages originated by communities appearing in the agent's SNMP community names table in accordance with the access rights, as explained above. Thus a **setRequest** for a MIB object with read-write access rights will nevertheless be rejected if it comes from a management station whose community has read-only rights with respect to that particular agent.

B.3 IP Environment

This section provides general information on the IP environment.

IP Address Structure

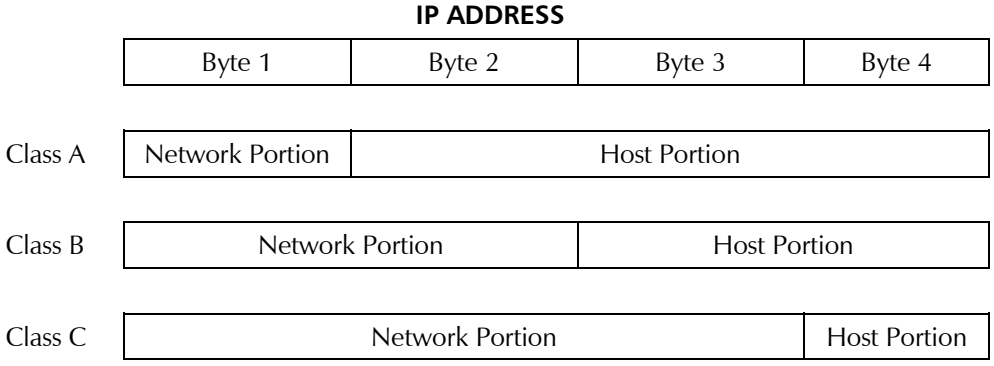
Under the IP protocol, each IP network element (SNMP agents, network management stations, etc.) is called an IP host and must be assigned an IP address. An IP address is a 32-bit number, usually represented as four 8-bit bytes. Each byte represents a decimal number in the range of 0 through 255.

The address is given in decimal format, with the bytes separated by decimal points, e.g., 164.90.70.47. This format is called ***dotted quad notation***.

An IP address is logically divided into two main portions:

- **Network Portion –** The network portion is assigned by the Internet Assigned Numbers Authority (IANA). There are five IP address classes: A, B, C, D, and E. However, only the classes A, B and C are used for IP addressing. Consult your network manager with respect to the class of IP addresses used on your network.

The network portion of an IP address can be one, two or three bytes long, in accordance with the IP address class. This arrangement is illustrated below:



The class of each IP address can be determined from its leftmost byte, in accordance with the following chart:

Address Class	First Byte	Address Range
Class A	0 through 127	0.H.H.H through 127.H.H.H
Class B	128 through 191	128.N.H.H through 191.N.H.H
Class C	192 through 223	192.N.N.H through 223.N.N.H

N – indicates bytes that are part of the network portion
H – indicates bytes that are part of the host portion

- **Host Portion –** The host portion is used to identify an individual host connected to the network. The host identifier is assigned by the using organization, in accordance with its specific needs.

  Often, the host portion is further sub-divided into two portions:

  - **Subnet number** – For example, subnet numbers can be used to identify departmental subnetworks. The subnet number follows the network identifier.
  - **Host number** – the last bits of the IP address.

Note *The all-zero host identifier is always interpreted as a network identifier, and must not be assigned to an actual host*.

Net and Subnet Masks

Net and subnet masks are used to help filter the relevant traffic more efficiently: the function of the net and subnet mask is to specify how many of the IP address bits are actually used for the net identifier and for the subnet number.

The mask is a 32-bit word that includes "***ones***" in the positions used for net and subnet identifications, followed by "***zeros***" up to the end of the IP address. For example, the subnet mask corresponding to the Class C IP address 194.227.31.67 is 255.255.255.000.

Recommendations for Selection of IP Addresses

When the FCD-E1 SNMP agent and its management station are connected to the same network, the network identifier part of the IP address assigned to the SNMP agent must be identical to the network identifier part of the IP address of the management station.

However, the agent and the FCD-E1 SNMP management station can also be on different IP networks. In this case, each one will be assigned IP addresses according to its IP network.

You can also specify a default gateway. The default gateway is the router to be used by default for routing the management traffic to the management station (located on a different IP network).

Automatic Routing of IP Traffic

The SNMP agent of the FCD-E1 units includes a proprietary IP router function, that is used to route management messages automatically.

The proprietary IP router operates both on the in-band, as well as on the out-of-band traffic, depending on the communication methods that have been enabled.

The router of each SNMP agent collects information on the other SNMP agents whose messages pass through by monitoring the IP source and destination addresses of the IP messages, and combining this information with the information on the direction to the management station. This automatic learning capability enables using any network topology, including topologies with closed loops.

B.4 Handling of Management Traffic

Handling of Out-of-Band Communication

Out-of-band communication is performed via the management ports of the FCD-E1 unit.

When using out-of-band communication through a port of a FCD-E1 unit, the IP router must know which of the two serial ports (CONTROL DCE, located on the front panel, and/or CONTROL DTE, located on the rear panel), are to be used for management.

This information is provided during the configuration of the supervisory ports, using the **`DEF SP`** and **`DEF DP`** commands (for CONTROL DCE and CONTROL DTE ports, respectively):

- A port that is connected to the network management station is defined as the NMS port in the AUXILIARY DEVICE parameter.
- A port that is connected to a serial port of another equipment unit is defined as an AGENT port.

Note *A serial port can be configured for management access only when its interface is configured as DCE.*

Typically, the CONTROL DCE port is used for out-of-band communication, and the CONTROL DTE port is used as a dial-out port.

Out-of-band management uses a RAD proprietary protocol for management traffic handling. The user can also enable the transmission of RIP2 routing tables through each port, thereby enabling the transfer of management traffic through routers using the RIP2 protocol.

Handling of Inband Communication

When using inband communication, the IP router can receive the management traffic through either, or both the main and sublinks. Different protocols and routing methods can be configured for each link.

Inband Communication Ports and Protocols

When using inband communication, the user can select the link bandwidth allocated to management and the transmission and routing management protocols:

- Management traffic carried within the E1 frame overhead. This communication mode uses the RAD proprietary protocol, which requires a small fraction of the link bandwidth: the management traffic is carried by means of the national bits, S_{a4} through S_{a8}, in timeslot 0 (each bit can carry a data rate of 4 kbps).
- Management traffic carried in a dedicated timeslot. This communication mode supports the following protocols:
  - RAD proprietary protocol
  - Frame relay encapsulation in accordance with RFC 1490
  - RIP2 protocol.

When a dedicated timeslot is used, the data rate is selectable (8, 16, 32, or 64 kbps), but the sublink supports only 8 kbps.

Inband Management Traffic Routing

The IP router function uses the RAD proprietary routing protocol whenever it operates in a network environment consisting of RAD products.

In addition, the IP router can be configured by the user to use frame relay and RIP2, when connecting directly to a router.

- The RAD proprietary routing protocol is used with the timeslot 0 and the dedicated timeslot option.
- The RIP2 protocol is available with a dedicated timeslot or frame relay options.
  - When the IP router function is configured to use the RAD proprietary protocol, it collects information on the other SNMP agents by exchanging routing information (including the contents of each router's routing table), with its neighbors. This automatic learning capability enables using any network topology, including topologies with closed loops.

Note *An SNMP agent accepts routing information messages only through the port defined as AGENT port, or through inband management.*

  - To enable the routing of management traffic by standard routers, the IP router function can be configured to use the standard RIP2 protocol. In this case, the FCD-E1 SNMP agent does not learn IP addresses through the AGENT port.
- When the management traffic is carried in a dedicated timeslot, it is also possible to use frame relay encapsulation in accordance with RFC 1490 (and if required, the RIP2 routing protocol). This enables using frame relay routers to carry the management traffic to the managed FCD-E1.
- Frame relay encapsulation is used as follows:
  - In the transmit direction, the SNMP agent encapsulates the management messages in frames with a predetermined DLCI (always DLCI 100), and sends them at the selected rate through the selected main link timeslot.
  - In the receive direction, the SNMP agent monitors the specified timeslot, analyzes packets received with DLCI 100, and analyzes the received data to detect management messages (any such messages are then processed as usual).

Note *FCD-E1 SNMP agent does not support frame relay management protocols (ANSI T1.617 Annex D, LMI, etc.), nor is such support required.*

The RAD proprietary protocol provides better routing capabilities, therefore it is recommended to use it whenever feasible.

Preventing Management Access to the Other Network Equipment

By default, the internal IP router function of the FCD-E1 SNMP agent will route management traffic received through any link configured for management access, to all the other links and ports that are also configured for management access.

There are certain applications in which this is not desirable: a particular configuration of this type is a link that ends in equipment managed by a “foreign” management station, which should not be able to access the other equipment in the network.

To prevent a management station from accessing other equipment through the IP router function of the FCD-E1 SNMP agent, the user can configure that link for operation using a dedicated timeslot for management traffic but without enabling any routing protocol (i.e., neither the RAD proprietary, not the RIP2 routing protocol).

B.5 SNMP Traps

The FCD-E1 SNMP agent supports the standard MIB-II traps. In addition, each FCD-E1 alarm is sent as a specific trap to the management station.

Appendix C
Operating Environment

C.1 Scope

This appendix presents a concise description of the operating environment of FCD-E1 systems, to provide th

e background information required for understanding the FCD-E1 configuration and performance monitoring parameters.

C.2 E1 Environment

E1 (CEPT) Signal Structure

The E1 line operates at a nominal rate of 2.048 Mbps. The data transferred over the E1 line is organized in frames. The E1 frame format is shown in *Figure C-1*.

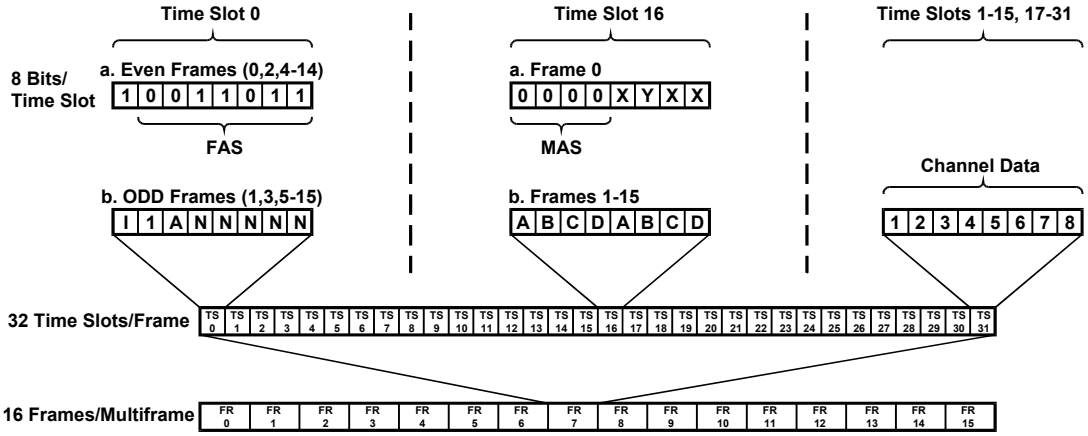

Time Slot 0
Time Slot 16
Time Slots 1-15, 17-31
8 Bits/ Time Slot
a. Even Frames (0,2,4-14)
1 0 0 1 1 0 1 1
FAS
a. Frame 0
0 0 0 0 X Y X X
MAS
Channel Data
b. ODD Frames (1,3,5-15)
I 1 A N N N N N
b. Frames 1-15
A B C D A B C D
1 2 3 4 5 6 7 8
32 Time Slots/Frame
TS 0 TS 1 TS 2 TS 3 TS 4 TS 5 TS 6 TS 7 TS 8 TS 9 TS 10 TS 11 TS 12 TS 13 TS 14 TS 15 TS 16 TS 17 TS 18 TS 19 TS 20 TS 21 TS 22 TS 23 TS 24 TS 25 TS 26 TS 27 TS 28 TS 29 TS 30 TS 31
16 Frames/Multiframe
FR 0 FR 1 FR 2 FR 3 FR 4 FR 5 FR 6 FR 7 FR 8 FR 9 FR 10 FR 11 FR 12 FR 13 FR 14 FR 15
Notes
I International Bit
N National Bit
A Alarm Indication Signal (Loss of Frame Alignment - Red Alarm)
FAS Frame Alignment Signal, Occupies alternate (but not necessarily even) frames
ABCD ABCD Signaling Bits
X Extra Bit
Y Loss of Multiframe Alignment
MAS Multiframe Alignment Signal

Figure C-1. E1 (CEPT) Frame Format

Each E1 frame includes 256 bits. The 256 bits are arranged in 32 timeslots of eight bits each that carry the data payload. The frame repetition rate is 8,000 per second, and therefore the data rate supported by each timeslot is 64 kbps. The number of timeslots available for user data is maximum 31, because timeslot 0 is reserved.

TimeSlot 0

Timeslot 0 is used for two main purposes:

- Delineation of frame boundaries. For this purpose, in every second frame timeslot 0 carries a fixed pattern, called frame alignment signal (FAS). Frames carrying the FAS are defined as even frames, as they are assigned number 0, 2, 4, etc. when larger structures (multiframes) are used. The receiving equipment searches for this fixed pattern in the data stream using a special algorithm, a process called frame synchronization. Once this process is successfully completed, the equipment can identify each bit in the received frames.
- Transmission of housekeeping information. In every frame without FAS (odd frames), timeslot 0 carries housekeeping information. This information includes:
  - Bit 1 - this bit is called the international (I) bit. Its main use is for error detection using the optional CRC-4 function.
  - Bit 2 is always set to 1, a fact used by the frame alignment algorithm.
  - Bit 3 is used as a remote alarm indication (RAI), to notify the equipment at the other end that the local equipment lost frame alignment, or does not receive an input signal.
  - The other bits, identified as S_{a4} through S_{a8}, are designated national bits, and are actually available to the users, provided agreement is reached as to their use. RAD equipment with SNMP agents can use the S_{a4} -S_{a8} bits for inband management traffic. The total data rate that can be carried by a national bit, including the S_{a4} bit, is 4 kbps.

Multiframes

To increase the information carrying capacity without wasting bandwidth, the frames are organized in larger patterns, called multiframes. Two types of multiframes are generally used:

- 256N, which consists of 2 frames (one odd frame and one even frame). The 256N multiframe is generally used when timeslot 16 is available to the user. In this mode, the maximum number of timeslots available for payload is 31 (maximum payload data rate of 1984 kbps). For systems that use the common-channel signaling (CCS) method, the CCS information is often transmitted in timeslot 16.
- 256S, which consists of 16 frames. The 256S multiframe is generally used when timeslot 16 serves for the transmission of end-to-end signaling using channel-associated signaling (CAS). CAS is typically used on links that transfer voice channels. In this mode, the maximum number of timeslots available for payload is 30 (maximum data rate of 1920 kbps).
  The 256S multiframe requires a special multiframe alignment sequence (MAS), which is carried in timeslot 16 (see *Figure C-1*), together with the Y bit, which indicates loss of multiframe alignment. As shown in *Figure C-1*, four signaling bits, designated A, B, C, and D, are available for each channel, thereby enabling end-to-end transmission of four signaling states. Each frame in the multiframe carries the signaling information of two channels.

E1 Line Statistics Using CRC-4 Error Detection

The FCD-E1 supports the CRC-4 function in accordance with ITU-T Rec. G.704, which allows the evaluation of the quality of transmission over E1 links.

When the CRC-4 option is enabled, frames are arbitrarily grouped in groups of 16 (these groups are called CRC-4 multiframes, and do not bear any relationship to the 16-frame multiframe structures used with the 256S super-frame explained above). A CRC-4 multiframe always starts with a frame that carries the frame alignment signal. The CRC-4 multiframe structure is identified by a six-bit ***CRC-4 multiframe alignment signal,*** which is multiplexed into bit 1 of timeslot 0 of each odd-numbered (1, 3, 5, etc.) frame of the multiframe (up to frame 11 of the CRC-4 multiframe). Each CRC-4 multiframe is divided into two submultiframes of 8 frames (2048 bits) each.
The detection of errors is achieved by calculating a four-bit checksum on each 2048-bit block (submultiframe). The four checksum bits calculated on a given submultiframe are multiplexed, bit by bit, in bit 1 of timeslot 0 of each even-numbered frame of the next submultiframe.

At the receiving end, the checksum is calculated again on each submultiframe and then compared against the original checksum (sent by the transmitting end in the next submultiframe). The results are reported by two bits multiplexed in bit 1 of timeslot 0 in frames 13, 15 of the CRC-4 multiframe, respectively. Errors are counted and used to prepare statistic data on transmission performance.

E1 (CEPT) Line Signal

The basic E1 line signal is coded using the High-Density Bipolar 3 (HDB3) coding rules. The HDB3 coding format is an improvement of the alternate mark inversion (AMI) code.

In the AMI format, “ones” are alternately transmitted as positive and negative pulses, whereas “zeros” are transmitted as a zero voltage level. The AMI format cannot transmit long strings of “zeros”, because such strings do not carry timing information.

The HDB3 coding rules restrict the maximum length of a “zero” string to 3 pulse intervals. Longer strings are encoded at the transmit end to introduce non-zero pulses. To allow the receiving end to detect these artificially-introduced pulses and to enable their removal to restore the original data string, the encoding introduces intentional bipolar violations in the data sequence. The receiving end detects these violations and when they appear to be part of an encoded “zero” suppression string - it removes them.

Bipolar violations which are not part of the HDB3 zero-suppression string are assumed to be caused by line errors, and are counted separately, to obtain information on the quality of the transmission link when the CRC-4 function is not used.

E1 (CEPT) Line Alarm Conditions

- **Excessive bit error rate.** The bit error rate is measured on the frame alignment signal. The alarm threshold is an error rate higher than 10^{-3} that persists for 4 to 5 seconds. The alarm condition is canceled when the error rate decreases below 10^{-4} for 4 to 5 consecutive seconds.
- **Loss of frame alignment** (also called loss of synchronization). This condition is declared when too many errors are detected in the frame alignment signal (FAS), e.g., when 3 or 4 FAS errors are detected in the last 5 frames. Loss of frame alignment is cleared after no FAS errors are detected in two consecutive frames. The loss of frame alignment is reported by means of the A bit (see *Figure C-1*).
- **Loss of multiframe alignment** (applicable only when 256S multiframes are used). This condition is declared when too many errors are detected in the multiframe alignment signal (MAS), as for loss of frame alignment. The loss of multiframe alignment is reported by means of the Y bit (see *Figure C-1*).
- **Alarm indication signal (AIS)**. The AIS signal is an unframed “all-ones” signal, and is used to maintain line signal synchronization in case of loss of input signal, e.g., because an alarm condition occurred in the equipment that supplies the line signal. Note that the equipment receiving an AIS signal loses frame synchronization.

Appendix D
Command Language

D.1 General

This appendix provides a detailed description of the FCD-E1 supervision language.

The information appearing in this appendix assumes that the user is familiar with the FCD-E1 system and with its configuration parameters. If necessary, review *Appendix C* for a description of the FCD-E1 operating environment, *Chapter 4* for a general description of the FCD-E1 supervision language syntax, and *Chapter 1* for a functional description of the FCD-E1 system.

D.2 Front Panel Parameters

This section lists the FCD-E1 configuration parameters and their functions. The information is organized in tables for each group of parameters:

Group	Display	Refer to
System parameters	SYSTEM PARAMETER	*Table D-1*
Main link and sublink parameters	LINK PARAM	*Table D-2*
Supervisory port parameters	SP PARAMETERS	*Table D-3*
Data channel parameters (CH1 and CH2)	CHANNEL PRM	*Table D-4*
BER test parameters	BERT PRM	*Table D-5*
Download parameters	DNLOAD PRM	*Table D-6*

The tables also list the parameter values included in the FCD-E1 default configuration and important practical configuration guidelines.

The test parameters appearing under the TEST OPTION menu are described in ***Error! Cannot open file.*** in *Chapter 5*. The performance diagnostics parameters for the main link and sublink appearing under the DIAGNOSTICS menu are described in ***Error! Cannot open file.*** in *Chapter 5*.

Note

In addition to the parameters listed in the tables, FCD-E1 supports other parameters, which can be modified only via the supervisory port. These parameters are listed and explained in the Supervisory Terminal on page D-13.

Table D-1. System Configuration Parameters

Designation	Function	Values	Configuration Guidelines
CLK_MASTER	Selects the master system timing reference.	**INT** – Internal oscillator. **ML** – Locked to the recovered main link receive clock **SL** – Locked to the recovered sublink receive clock **CH_1, CH_2** – Locked to the external clock supplied to the corresponding user data channel, provided the channel timing mode is DTE2 **Default: INT**	Select ML or SL for connection to carrier lines. Select one of the data channels for connection to a data network. Select INT at one end and ML at the other end for point-to-point lines.
CLK_FBACK	Selects the alternate (fallback) system timing reference, for use in case the master reference fails.	**NONE** – No fallback source is used. In this case, the internal oscillator is automatically selected when the master reference fails **ML** – Locked to the recovered main link receive clock **SL** – Locked to the recovered sublink receive clock **CH_1, CH_2** – Locked to the external clock supplied to the corresponding user data channel, provided the channel timing mode is DTE2 **Default: NONE**	Select a source different from that selected as master. Select NONE to disable switching to the fallback source. In this case, the default fallback clock source is the FCD-E1 internal clock oscillator.

Table D-2. Link Configuration Parameters

Designation	Function	Values	Configuration Guidelines
FRAME	Selects the multiframing mode for the main link and the sublink	**G732N** – 2 frames per multiframe. Timeslot 16 can be used for user data. **G732S** – 16 frames per multiframe. **UNFRM** – Unframed G.703 signal, carrying the data applied to channel 1 **Default: G732N**	Select the framing mode specified for use in your network on the corresponding link. If some of the timeslots of a link are configured as voice type slots, that link must use the G732S mode, otherwise you will see CONFIG ERROR 006. For transmission of unframed data, select UNFRAME for the main link. In this case, all the ports except channel 1 are disabled (the data rate of channel 1 is automatically set to 2048 kbps).
SYNC	Used to change the frame alignment algorithms, to reduce the time required for the link to return to normal operation after loss of sync	**CCITT** – Complies with ITU-T Rec. G.732 **FAST** – After 1 second **62411** – Complies with AT&T TR-62411 (after 10 sec) **Default: CCITT**	Select CCITT, unless your application has special requirements.
FUNCTION	Displays the type of main link interface	**DSU** – FCD-E1 does not include an LTU **LTU** – FCD-E1 includes an LTU	
IDLE CODE	Selects the code transmitted to fill idle (unused) timeslots in the main link frame	The following bit sequences are available (presented as hexadecimal numbers): 7F, 98, FF. You can also select any other sequence. **Default: 3F**	Select one of the three commonly used values, 7F, 98 or FF, or any value specified for use on the corresponding link in your network. Select the same value at the other end. FCD-E1 allows you to select any two-digit hexadecimal value.
CRC-4	Enables the generation of check bits (in accordance with the CRC-4 polynomial specified by ITU-T Rec. G.704)	**NO** – CRC-4 option disabled **YES** – CRC-4 option enabled **Default: NO**	Select YES, except when FCD-E1 link is connected to transmission equipment that does not support this option.
RAI	Selects whether remote alarm indication is sent to the sublink if a local or remote alarm exists in the main link.	**DISABLE** – RAI transfer disabled **ENABLE** – RAI transfer enabled **Default: DISABLE**	

Table D-2. Link Configuration Parameters (Cont.)

Designation	Function	Values	Configuration Guidelines
OOS SIGNAL	When the CGA NONE mode is selected, this parameter determines the state of the A, B signaling bits sent to the main link during the periods the sublink is out-of-service. The signaling bits C and D are not affected (C is always "0", and D is always "1"). Not displayed for G732N multiframes	**SPACE** – Both A and B signaling bits are forced to "1" during out-of-service periods. **MARK** – Both A and B signaling bits are forced to "0" during out-of-service periods. **SP_MK** – The A and B signaling bits are forced to "1" for 2.5 seconds, then switch to the "0" state until the out-of-service condition disappears. **MK_SP** – The A and B signaling bits are forced to "0" for 2.5 seconds, then switch to the "1" state until the out-of-service condition disappears. **Default: SPACE**	When NONE is used for CGA, select the OOS signaling mode used by the equipment connected to the corresponding link (relevant for sublink only).
Note: *"1" – on-hook (idle) state "0" – off-hook (busy) state. This parameter is displayed only for FCD-E1 versions with a sublink.*			
OOS CODE	When either the CGA NONE or TRANS mode is selected, determines the code transmitted during out-of-service periods in the timeslots transferred between the sublink and the main link.	The available selections are 00 through FF (hexa) **Default: FF**	When NONE or TRANS is used for CGA, select the out-of-service code recommended for use in your network (relevant for sublink only).
Note: *This parameter is displayed only for FCD-E1 versions with a sublink.*			

Table D-2. Link Configuration Parameters (Cont.)

Designation	Function	Values	Configuration Guidelines
CGA	Selects the method used to signal the CGA (link out-of-service) state to the other link. The main link timeslots assigned to the sublink carry the signaling.	**NONE** – When the FCD-E1 sublink is in the out-of-service state, the main link timeslots assigned to the sublink carry the OOS code. In addition, the signaling bits A, B also assume the OOS state (see OOS SIGNAL). **TRANS** – Same as for NONE, but the signaling bits A, B are not forced to the OOS state. **FULL** –FCD-E1 does not change the state of the main link timeslots, or the state of the signaling bits. **Default: NONE**	The recommended signaling method depends on the application. The NONE mode is non-transparent and is often used when the sublink carries voice channels, for example, in PABX or voice multiplexer applications. The FULL mode is fully transparent and is often used when the sublink carries channelized or unchannelized data. Use the TRANS mode for voice applications with channel associated signaling (proprietary signaling) and for channelized data applications. This is the transparent mode.
Note: *This parameter is displayed only for FCD-E1 versions with a sublink.*			
MAP MODE	Determines the selection method for the sublink timeslots transferred to the main link.	**USER** – Free user selection of timeslots. **SEQ** – Sequential selection of timeslots from a user-specified slot. **Default: USER**	The selected sublink timeslots are allocated the same timeslots in the main link frame.
Note: *This parameter is displayed only for FCD-E1 versions with a sublink.*			
TS TYPE 1..31 (when USER is selected in MAP MODE) **TS TYPE** (when SEQ is selected in MAP MODE)	Controls the timeslot connection state and type.	**NC** – Timeslot not connected to the main link **DATA** – Timeslot handled as a data timeslot **VOICE** – Timeslot handled as a voice timeslot **Default: NC**	In USER mode, the type can be individually selected for each timeslot In SEQ mode, the selected type applies to all the timeslots in the bundle
START TS	Selects the starting timeslot for the SEQ timeslot selection mode	Any number in the range of 1 to 31, consistent with the desired number of user timeslots and with the data channel timeslot allocations. **Default: 1**	Do not select timeslot 16 when the framing mode is G732N.
NUM OF TS	Selects the total number of timeslots transferred as a bundle from the sublink to the main link, when using the SEQ mode	Any number in the range of 1 to 31, consistent with the desired number of user timeslots and with the data channel timeslot allocations **Default: 1**	

Table D-3. Supervisory Configuration Parameters

Designation	Function	Values	Configuration Guidelines
SPEED	Selects supervisory port data rate.	**300, 1200, 2400, 4800, 9600, 19200** – Supervisory port data rates in bps **AUTO** – Autobaud operation. **Default: AUTO**	Select AUTO in order for FCD-E1 to automatically identify the incoming traffic data rate. To enable positive identification, the transmission must start with three consecutive Carriage Returns. Do not use Autobaud when the CONTROL DCE port is configured for the SLIP protocol.
Note: *The 19200 and AUTO selections are not available for the CONTROL DTE port*			
DATA	Selects the number of data bits in the CONTROL DCE port word format	**7, 8** – Number of data bits **Default: 8**	The supervisory port word format should be the same as on the terminal.
PARITY	Controls the use of parity	**ODD** – Odd parity **EVEN** – Even parity **NO** – Parity disabled **Default: NO**	The supervisory port word format should be the same as on the terminal.
INTERFACE	Selects interface of the CONTROL DCE supervisory port	**DCE** – The CONTROL DCE port appears as DCE for external equipment **DTE** – The CONTROL DCE port appears as DTE for connection via modem to the external equipment **Default: DCE**	Select DCE when FCD-E1 is connected directly to the terminal. Select DTE when FCD-E1 is connected to the terminal via a modem.
AUX-DEV	Selects the management mode supported by the CONTROL DCE port.	**TERMINAL** – The CONTROL DCE port is connected using an ASCII supervision terminal **SLIP-NMS** – The DCE control port connects to an SNMP management station and/or Telnet host using the SLIP protocol **SLIP_AGN** – The DCE control port connects to another agent port using the SLIP protocol **Default: TERMINAL**	Select SLIP-NMS when the supervisory port must be able to use the SLIP protocol, for example SNMP or Telnet management. Select TERMINAL if only the supervision terminal must be supported.
Note: *At any time only one of the two ports of the FCD-E1 can be used for management access.*			

Table D-3. Supervisory Configuration Parameters (Cont.)

Designation	Function	Values	Configuration Guidelines
CALL ACT	Defines when the call-out function is activated	**A-CASE** – Call-out is activated in any case. **L-FAIL** – Call-out is activated only when a link failure occurs or there is loc or remote sync loss. **Default: A-CASE**	
CAL TRG	Controls the use of the call-out trigger	**NONE** – The call-out function is disabled **ALL** – The FCD-E1 will initiate a call after each new alarm **MAJOR** – The FCD-E1 will initiate a call only when a new major alarm condition is detected. **Default: NONE**	

The channel parameters are independently selected for each user data channel.

Table D-4. Data Channel Configuration Parameters

Designation	Function	Values	Configuration Guidelines
MULTIPLIER	Selects the basic data rate supported by each timeslot. All user data rates are multiples of the selected rates.	**64K** – Data channel rate is a multiple of 64 kbps **56K** – Data channel rate is a multiple of 56 kbps **Default: 64**	Select the basic rate that suits the operating mode of the equipment connected to the corresponding data channel, 56 kbps or 64 kbps. For channel 2 of an FCD-E1 with Ethernet interface, this selection applies to the throughput; therefore it is not recommended to select 56 kbps.
SPEED	Indicates user channel data rate (for Ethernet LAN interface: indicates the throughput)	Available data rates are multiples of the basic rate (56 or 64 kbps). The multiples are in the range of 1 to 31, resulting in rates of 56, 112, ..., 1736 kbps or 64, 128, 192, ..., 1984 kbps, respectively. In the unframed mode, you can select 32 (2048 kbps) for channel 1 To disconnect the channel, select NC **Default: NC**	Select the data rate used by the equipment connected to the corresponding data channel. The speed is a multiple *n*, of the basic rate. *n*, in the range of 1 through 31, actually indicates the number of main link timeslots that are needed to carry the data stream connected to the channel. This is true even when multiples of 56 kbps are used, because stuffing is used to ensure the minimum "1" density. A "1" density compatible with transmission over E1 links is obtained by adding one bit, which is always a "1", after each group of seven bits; this effectively increases the data rate from 56 kbps to 64 kbps.
FIFO SIZE	Selects the size of the user FIFO buffer used in the data channel	**AUTO** – Automatic size selection in accordance with the jitter that must be tolerated at each data rate. **32, 60, 104, 144** – Buffer size, in bits (corresponds to FIFO lengths of ±16, ±24, ±52 and ±72 bits). **Default: AUTO**	In the DCE and DTE1 clock modes, it is not necessary to increase the FIFO size because the buffer size is automatically set by FCD-E1. If the DTE2 mode is used and the jitter expected in a specific application is higher than what can be tolerated when using the automatically selected size, you can manually select a FIFO size greater than the AUTO size.

Table D-4. Data Channel Configuration Parameters (Cont.)

Designation	Function	Values	Configuration Guidelines
CLOCK MODE	Selects the clocking mode of this user data channel. For the Ethernet interface, only the DCE mode is supported, and therefore it cannot be changed	**DCE** – FCD-E1 operates as a DCE and provides transmit and receive clocks to the synchronous user DTE. **DTE1** – FCD-E1 supplies the receive clock to the user equipment and accepts the user transmit clock. **DTE2** – FCD-E1 requires transmit and receive clocks from the user equipment. **Default: DCE**	Select the clock mode in accordance with the type of equipment connected to the user data channel: • **DCE** – For direct connection to a synchronous DTE. • **DTE1** – For connection via a modem with external clock or another equipment that accepts a receive clock and outputs a transmit clock. • **DTE2** – For connection via a modem or other type of equipment (such as a multiplexer), that provides both receive and transmit clocks. You must select this mode when FCD-E1 timing is to be locked to an external clock (see *CLK_MASTER* in *Table D-1*), or the external clock is intended for use as a fallback reference (see *CLK_FBACK* in *Table D-1*).
Notes: *1. The accuracy and stability of the external source clock must be compatible with system requirements, otherwise severe disruptions in network operation may occur.* *2. The DTE2 mode can be selected for only one channel, except in case both channels are connected to equipment using the same timing source.*			
INTERFACE	Displays the user data channel interface type	For CH1 – **V.35, RS-530, X.21 RS-449** For CH2 – **V.35, RS-530, X.21 RS-449, RS-232, ETUB** (10BaseT bridge)	Read-only parameter – displays the user data channel interface, installed for the current channel
CTS	Selects the state of the CTS line in the user data channel (not applicable to Ethernet interface)	**ON** – CTS continuously on **=RTS** – CTS line follows the RTS line **Default: ON**	Select in accordance with the desired operation mode of the channel. In general, you should use =RTS for operation in the polling mode. In this case, when the RTS line is OFF, the local FCD-E1 channel continuously sends MARK in its main link timeslots.
Note: *When the CTS line is not active (CTS=OFF), the user data interface generates an "all-ones" signal, transmitted via the main link to the far end.*			

Table D-4. Data Channel Configuration Parameters (Cont.)

Designation	Function	Values	Configuration Guidelines
MAP MODE	Selects the timeslot allocation method used for this data channel	**USER** – Free user selection of timeslots. **SEQ** – Sequential allocation of timeslots, starting from a user-specified slot. **Default: USER**	Select the desired mode, in accordance with system requirements. Remember that for each data channel, it is necessary to assign a number of main link timeslots equal to the *n*, the multiple of the basic rate that determines the channel data rate. Therefore, when you select the SEQ mode and a starting timeslot, FCD-E1 attempts to allocate the required number *n* of timeslots to the channel. Timeslot 16 is automatically skipped when G732S framing is used, however all the other timeslots within the required range are automatically included. This may result in conflicts with previous assignments. Such conflicts are automatically detected and reported by error messages. In case of conflict, you may use the USER mode to assign individual free timeslots to the data channel, until the required number of timeslot is reached.
Note: *All the timeslots assigned to data channels are always defined as data timeslots; this, however, does not preclude their use as voice channel carriers.*			
TS TYPE 1..31 (when USER is selected in MAP MODE parameter) **TS TYPE** (when SEQ is selected in MAP MODE parameter)	Selects the timeslot connection state	**NC** – Timeslot not connected **DATA** – Timeslot is connected and is handled as a data timeslot **Default: NC**	
START_TS	Selects the starting timeslot for SEQ timeslot allocation	Any number in the range of 1 to 31, consistent with the desired number of user timeslots and when applicable, with the timeslots used by the sublink. **Default: 1**	

Table D-5. BERT Configuration Parameters

Designation	Function	Values	Configuration Guidelines
PATTERN	Selects the test pattern for the data channel	The available selections are the QRSS test pattern and the following pseudo-random sequences: 2E3-1, 2E4-1, 2E5-1, 2E6-1, 2E7-1, 511, 2E10-1, 2047, 2E15-1, 2E17-1, 2E18-1, 2E20-1 QRSS, 2E21-1, 2E22-1, 2E23-1, 2E25-1, 2E28-1, 2E29-1, 2E31-1, 2E32-1 **Default: 2E3-1**	
ERR RATE	Enables the injection of a calibrated rate of errors in the transmitted test pattern	**NO ERR** – Disables the injection of errors. **SINGLE** – Injects a single error when **<Enter>** is pressed. **10E-1, 10E-2, 10E-3, 10E-4, 10E-5, 10E-6, 10E-7** – Error injection at the selected rate. **Default: NO ERR**	
RX INBND	Enables the activation of a remote loopback in response to the reception of the inband loopback command from the remote system	**ENABLE** – Inband loopback command accepted. **DISABLE** – Inband loopback command ignored. **Default: DISABLE**	

Table D-6. Download Configuration Parameters

Designation	Function	Values	Configuration Guidelines
MODE	Selects the inband transmission mode for the selected link	**NONE** – Inband SNMP and Telnet traffic is ignored and FCD-E1 does not generate such traffic **TS0/F** – Inband SNMP and Telnet traffic is received and transmitted in timeslot 0 **DEDIC** – Inband SNMP and Telnet traffic is received and transmitted in a dedicated, user-selected timeslot **FR** – For Main link only. Inband SNMP and Telnet traffic is received and transmitted in a dedicated, user-selected timeslot **Default: NONE**	
TS NUM	Selects the dedicated timeslot used for the selected link.	Any number in the range of 1 through 31, consistent with the available timeslots **Default: 1**	This parameter is displayed only when the DEDIC or Frame Relay mode is selected
SPEED	Selects the data rate used to transfer inband the management traffic for the selected link.	The management traffic data rate is given in kbps: **8, 16, 32, 64** **Default: 8**	This parameter is displayed only when the DEDIC or Frame Relay mode is selected and is relevant to ML. The SL is fixed at 8 kbps.

D.3 Supervisory Terminal Commands

The commands described in this section are listed in alphabetical order (see the *FCD-E1 Explicit Command Set Index* table for a complete list). If you need explanations on mnemonic commands, first use the *FCD-E1 Mnemonic Command Set Index* table in Chapter 4 to find the corresponding explicit command format. The description includes the command format, usage, and options.

The following notational conventions are used below:

[ ]	square brackets indicate optional entry/parameter.
{ }	accolades indicate required entry/parameter.
‘ ’	single quotes delimit user entry.
<Enter>	indicates the pressing of the carriage return key.

Note

The screens appearing in this appendix are given for illustration purposes only, and must not be construed as providing typical parameter values. Parameter values must be selected in accordance with the specific requirements of each particular application. If necessary, contact RAD Technical Support Department.

BYE

Purpose

End the current Telnet session.

Syntax

BYE

Use

To end the current Telnet session, type:

```
BYE <Enter>
```

CLR ALM

Purpose

Clear the alarm buffer.

Syntax

CLR ALM [/A]

Use

To clear all the alarms (including ON/OFF alarms) type:

```
CLR ALM /A<Enter>
```

CLR LOOP

Purpose

Deactivate the specified user-initiated test or loopback.

Syntax

CLR LOOP

Use

1. To deactivate a main link loopback, type:

   CLR LOOP LOCAL ANALOG ML<Enter> or CLR LP LOC ANA ML<Enter>
   CLR LOOP REMOTE ANALOG ML<Enter> or CLR LP REM ANA ML<Enter>

   CLR LOOP LOCAL DIGITAL ML<Enter> or CLR LP LOC DIG ML<Enter>
   CLR LOOP REMOTE DIGITAL ML<Enter> or CLR LP REM DIG ML<Enter>

   To deactivate all main link loopbacks and tests, type:

   CLR LOOP ML<Enter> or CLR LP ML<Enter>

2. To deactivate a sublink loopback, type:

   CLR LOOP LOCAL ANALOG SL<Enter> or CLR LP LOC ANA SL<Enter>
   CLR LOOP REMOTE ANALOG SL<Enter> or CLR LP REM ANA SL<Enter>

   CLR LOOP LOCAL DIGITAL SL<Enter> or CLR LP LOC DIG SL<Enter>
   CLR LOOP REMOTE DIGITAL SL<Enter> or CLR LP REM DIG SL <Enter>
   CLR LOOP BERT SL<Enter> or CLR LP BERT SL <Enter>
   CLR LOOP INBAND SL<Enter> or CLR LP INBAND SL <Enter>

   To deactivate all sublink loopbacks and tests, type:

   CLR LOOP SL<Enter> or CLR LP SL<Enter>

3. To deactivate a channel loopback, type:

   CLR LOOP LOCAL CH X<Enter> or CLR LP LOC CH X<Enter>
   CLR LOOP REMOTE CH X<Enter> or CLR LP REM CH X<Enter>

   CLR LOOP BERT CH X<Enter> or CLR LP BERT CH X<Enter>
   CLR LOOP INBAND CH X<Enter> or CLR LP INBAND CH X<CR

   where X stands for the channel number.

   To deactivate all channel loopbacks and tests, type:

   CLR LOOP CH X<Enter> or CLR LP CH X<Enter>

Note

The deactivation of an inband loopback is made by repeatedly transmitting the deactivation sequence, therefore the loopback can be considered as deactivated only after approximately 2 seconds.

If no user-initiated loopback of the specified type is now connected, you will receive ERROR 052 (loop is not active).

DATE

Purpose

Set the date for the FCD-E1 internal clock.

Syntax

DATE

Use

1. To set the date type:
   DATE<Enter>
   FCD-E1 displays the day field:

```
DAY             = 09
```

2. Change by pressing **F** to increase and **B** to decrease the displayed values. When done, press **<Enter>** to display the month field.

```
MONTH           = 07
```

3. Change by pressing **F** to increase and **B** to decrease the displayed values. When done, press **<Enter>** to display the year field.

```
YEAR            = 2000
```

4. Change by pressing **F** to increase and **B** to decrease the displayed values. When done, press **<Enter>** to display the weekday field.

```
WEEK DAY        = SUN
```

5. To end, press **<Enter>** after the weekday field.

DEF AGENT

Purpose

Display and modify the current SNMP agent parameters. Refer to *Appendix B* for additional explanations.

To enable SNMP and Telnet management, it is necessary to define all the parameters.

Syntax

DEF AGENT

Use

1. To define the SNMP agent parameters, type:
   DEF AGENT<Enter>
   You will see the current agent parameters, under the header **OLD AGENT PARAMETERS**, followed by the entry line for the first parameter, **TELNET_APATHY_TIME**.

2. Select the desired value by pressing **<F>** or **<B>**, then press **<Enter>** to display the second line. Continue until all the parameters are defined, and then press **<Enter>** to continue.

   A typical display, as seen after all the parameters are selected, is shown below:

```
CURRENT AGENT PARAMETERS
------------------------
IP_ADDRESS IS         : = XXX.XXX.XXX.XXX
MAC_ADDRESS IS        : = XXX.XXX.XXX.XXX.XXX.XXX
READ COMMUNITY IS     : = PUBLIC
WRITE COMMUNITY IS    : = PRIVATE
TRAP COMMUNITY IS     : = PUBLIC
```

   where X stands for the digits of the IP and MAC address.

Table D-7 lists the agent's parameters, function and range of values.

Table D-7. SNMP Agent Parameters

Parameter	Function	Values
TELNET_APATHY_TIME	Selects the time, in minutes, after which a Telnet connection will be automatically terminated if no incoming activity is detected.	The available values are 10 min, 15 min and 20 min. **Default: 10MIN**
IP_ADDRESS	Type in the IP address assigned to the FCD-E1 SNMP agent	Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). **Default: 999.999.999.999**
MAC ADDRESS	Type in the MAC address assigned to the FCD-E1 SNMP agent	Use the dotted-quad format (six groups of digits in the range of 0 through 255, separated by periods). **Default: 999.999.999.999.999.999**
READ COMMUNITY	Type in the name of the SNMP community that has read-only authorization (the FCD-E1 SNMP agent will accept only **getRequest** and **getNextRequest** commands from management stations using that community).	Up to seven alphanumeric characters. **Default: public**
WRITE COMMUNITY	Type in the name of the SNMP community that has read-write authorization (the FCD-E1 SNMP agent will also accent **setRequest** commands from management stations using that community).	Up to seven alphanumeric characters. **Default: private**
TRAP COMMUNITY	Type in the name of the SNMP community to which the FCD-E1 SNMP agent will send traps.	Up to seven alphanumeric characters. **Default: public**

DEF ALARM MASK

Purpose

Display and modify the alarm masks (masked alarms are not reported).

The alarm masks permit to disable the generation of alarms by unused ports and to stop the generation of alarms during maintenance.

Syntax

DEF ALM MASK

Use

1. To display the alarm mask data form, type:
   DEF ALM MASK<Enter>
2. You will see the first line, used to select the group of alarms to be processed. A typical display is shown below:

```
GROUP                    ALL
SYSTEM                  USER
```

The functions of the fields are as follows:

GROUP Selects the group of alarms to be processed:

- **SYSTEM** System alarms.
- **ML** Main link alarms.
- **SL** Sublink alarms (only for FCD-E1 with sublink).
- **CH1** Channel 1 alarms.
- **CH2** Channel 2 alarms (only for FCD-E1 with Ethernet interface).

ALL Enables the masking of all alarms:

- **MASK** All the alarms of a specific group are masked.
- **USER** You can define the individual alarms to be masked.
- **NORMAL** None of the alarms in the specific group is masked.

3. Move the cursor to the desired field using the spacebar, and then change using the **F** or **B** keys.
   - If you select **MASK** or **NORMAL** for **ALL**, press **<Enter>** to end.
   - If you select **USER**, select the desired group of alarms, and then press **<Enter>** to display the group of alarms to be processed. A typical display is shown below:

```
ALARM NUMBER & DESCRIPTION                    MASKED
01 REAL TIME CLOCK BATTERY FAILURE            NO
```

The functions of the fields are as follows:

ALARM NUMBER Displays the first alarm number (code and description) in the selected group (see *Chapter 5*).

MASKED Enables the masking of the selected alarm:

- **YES** The alarm is masked.
- **NO** The alarm is not masked, and will be reported when generated.

4. Select the desired state for the current alarm by pressing the **<F>** or **<B>** key, and then press **<Enter>** to display the next alarm number. Repeat the procedure until all the alarms in the selected group have been defined. After the last alarm, you will see again the date and time, followed by the working prompt.

DEF AR

Purpose

Control the use of traps for alarms reporting.

Syntax

DEF AR

Use

1. To define the alarm reporting and relay indications, type:

   DEF AR<Enter>

   FCD-E1 displays the alarm data form.

```
ALARM              REPORT
MAJOR ON           NO
```

2. To display an additional row, press **<Enter>**. A typical data form as seen after all the lines have been displayed is shown below:

```
ALARM              REPORT
MAJOR ON           YES
MAJOR OFF          YES
MINOR ON           YES
MINOR OFF          YES
```

3. To change the current selections, bring the cursor to the desired field, and then press the **<F>** or **<B>** keys to display the desired mode (YES or NO). When done, press **<Enter>** to end.

The data form lists the alarm conditions, and the action to be taken for each alarm condition. The fields appearing on the data form are explained below.

ALARM The alarm condition:

- **MAJOR ON** Indication provided when a major alarm condition is detected.
- **MAJOR OFF** Indication provided when a major alarm condition disappears.
- **MINOR ON** Indication provided when a minor alarm condition is detected.
- **MINOR OFF** Indication provided when a minor alarm condition disappears.
- **REPORT** YES indicates that the corresponding alarm condition is reported by means of traps sent to management stations.

DEF BERT

Purpose

Define the BERT test conditions. Refer to *Table D-5* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF BERT CH {1 2}

Use

1. To define the BER test parameters for channel 1, type:
   DEF BERT CH 1<Enter>
2. To define the BER test parameters for channel 2, type:
   DEF BERT CH 2<Enter>
3. The BERT parameters data form is displayed:

PATTERN	ERROR_INJECTION_RATE	RX_INBAND
2E3-1	NO_ERR	DISABLE

4. Move the cursor to the desired field using the spacebar, and then change using the <**F**> or <**B**> keys. After making the desired selections, press **<Enter>** to end.

DEF CALL

Purpose

Define the call-out parameters for the FCD-E1 dial-out port (connector CONTROL DTE). The call-out function is enabled by means of the DEF DP port.

The specified call-out parameters are used by FCD-E1 to build the call command that is sent to the dial-out modem. The modem connected to the CONTROL DTE connector must be set up as follows (for convenience, the Hayes commands required to select the specified parameters are listed in brackets):

- Auto-answer mode (**AT S0=1**)
- Call set up in response to the **CONNECT** string (**AT X0**)
- No echo (**AT E0**)
- Verbose mode (no codes, e.g., **CONNECT** string instead of **0**) (**AT V1**).

Syntax

DEF CALL

Use

1. To define the CONTROL DTE call-out parameters, type:
   DEF CALL<Enter>
   The first page of the call-out parameters data form appears.

```
NUM_OF_RETRIES              WAIT_FOR_CONNECT      DIAL_MODE
     ALT_NUM_MODE
0    30 SEC                 TONE                  NO
```

2. Change the parameter values as follows:
   - Press the spacebar to bring the cursor to the beginning of the first field to be changed.
   - Press **F** or **B** to scroll among the available selections and change the selected field.
   - When the desired selection is displayed, press the spacebar to move to the next field.

The call-out parameters displayed on the first page of the data form and their range of values are explained in *Table D-8*.

Table D-8. Call-Out Parameters

Parameter	Function	Values
NUM_OF_RETRIES	Used to control the number of dialing retries. This parameter applies to both the primary and the alternate number. • If the call is not established after dialing the primary directory number for the specified number of times, FCD-E1 attempts to establish the call by dialing the alternate directory number (provided the use of an alternate number is enabled by means of the ALT_NUM_MODE parameter). • If the call cannot be established within the specified number of redialing attempts on neither of the two directory numbers, FCD-E1 stops the call attempts. When a new alarm report must be sent, the call attempts are started again. The user is notified that the call attempts failed by a message recorded in the alarm buffer (separate messages are provided for each directory number).	**0** – no redialing attempts are made in case the call is not established on the first attempt. **1–8** – in case the call is not established on the first attempt, FCD-E1 redials for the specified number of times. **Default: 0**
WAIT_FOR_CONNECT	Specifies the time FCD-E1 waits for an answer after each dialing attempt. • If the called station does not answer within the specified time, FCD-E1 disconnects. If additional call attempts are allowed, FCD-E1 redials immediately after disconnecting.	The available selections are 30, 45, or 60 seconds. **Default: 30**
DIAL_MODE	Used to select the dialing mode The appropriate dialing mode depends on the dialing mode supported by the telephone network.	**TONE** – the modem is instructed to use DTMF dialing. **PULSE** – the modem is instructed to use pulse dialing. **Default: TONE**
ALT_NUM_MODE	used to control the use of an alternate number. The alternate number is dialed used after the specified number of call attempts on the primary number failed	**NO** – no alternate number. In this case, FCD-E1 stops the call attempts after the specified number of call attempts on the primary number failed. **YES** – the use of an alternate number is enabled. **Default: NO**

3. When done, press **<Enter>** to display the second page of the call-out parameters data form. A typical display is shown below.

```
NEW PRIMARY NUMBER [MAX 20 CHARS] =
CURRENT PRIMARY DIAL COMMAND      = 'primary number'
```

The second page is used to enter a new primary directory number, and the second row displays the current primary directory number. The directory number can include up to 20 digits, including the * and # symbols.

4. After entering the desired directory number, press **<Enter>**:
   - If the ALT_NUM_MODE parameter is **NO** (no alternate number), FCD-E1 displays the TIME and DATE fields, followed by the FCD-E1 prompt.
   - If the ALT_NUM_MODE parameter is **YES**, press **<Enter>** to see the third page of the call-out parameters data form, used to enter a new alternate directory number. A typical display is shown below.

```
NEW ALTERNATE NUMBER [MAX 20 CHARS] =
CURRENT ALTERNATE NUMBER            = 'alternate number'
```

5. After entering the desired directory number, press **<Enter>** to end.

DEF CHANNEL

Purpose

Define the data channel parameters. Refer to *Table D-4* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF CH {1 2}

Use

1. To define the data channel parameters, type:

   DEF CH 1<Enter> or DEF CH 2<Enter>

Note

Specifying channel 2 for an FCD-E1/1/, promotes ERROR 054 (illegal parameter for current configuration).*

The first line of the channel parameters data form is displayed.

```
MULTIPLIER          SPEED(KBPS)          FIFO_SIZE
  CLK_MODE          CTS
64 NC               AUTO                 DCE                  ON
```

2. Change the desired parameters and then press **<Enter>** to display the next line. If the channel interface is ETHERNET, you will see the Ethernet port configuration parameters line, otherwise you will see the timeslot mapping line (*Step 3* below). A typical Ethernet port configuration parameters line is shown below.

```
ETHERNET MODE       BRIDGING
HALF                FILTER
```

In case the data channel has an Ethernet interface, this line is the last line of the data form, and pressing <Enter> ends the command.

3. Change the desired parameters and then press **<Enter>** to display the next line. A typical form is shown below.

```
MAP_MODE        START_TS        TS_TYPE
SEQ             1               NC
```

4. When done, press **<Enter>**.
   - If in step 3 the MAP MODE has been set to SEQ, FCD-E1 displays the time and date followed by the FCD-E1 prompt.
   - If the MAP MODE has been set to USER, after you press **<Enter>** you will see the first line of the timeslot map of the channel being currently configured. A typical display is shown below:

```
TS    : NO 01   NO 02   NO 03   NO 04   NO 05   NO 06   NO 07
        NC      NC      NC      NC      NC      NC      NC
```

     - Use the spacebar to move between timeslots. For each timeslot, select between DATA (timeslot allocated to the current channel) and NC (not connected) by pressing **<F>** or **<B>.**
     - After completing the first line, press **<Enter>** to continue to the next line. Repeat the procedure until all the timeslots are defined. The maximum number of timeslots is 31.

5. When done, press **<Enter>** to end.

Table D-9 describes additional parameters of the data channel available only through the supervisory terminal.

Table D-9. Additional Data Channel Parameters

Parameter	Function	Values
ETHERNET MODE	Selects the Ethernet LAN traffic transfer mode. For FCD-E1 without Ethernet interface, this parameter is not displayed	**HALF** – Half duplex operation. **FULL** – Full duplex operation. **Default: HALF**
BRIDGING	Selects the Ethernet traffic processing mode. For FCD-E1 without Ethernet interface, this parameter is not displayed	**FILTER** – The internal bridge of FCD-E1 is enabled, and filters the traffic transferred to the remote end. **TRANS** – The internal bridge of FCD-E1 is disabled, and the Ethernet traffic is transparently transferred (LAN extender function). **Default: TRANS**

DEF DOWNLOAD

Purpose

Define the inband management communication parameters. Refer to *Table D-6* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF DNLOAD {ML SL}

Use

1. To define the inband management communication parameters for the link, type:
   DEF DNLOAD ML<Enter> or DEF DNLOAD SL<Enter>
   The first line of the data form is displayed. A typical line is shown below:

```
DNLOAD MODE
NONE
```

Note

If you specify the sublink for an FCD-E1/, you will see ERROR 054 (illegal parameter for current configuration).*

2. Select the desired mode, and then press **<Enter>**.
   If the DEDIC TS mode is selected the following line of the data form appears:

```
TS_NUM          SPEED
1               8
```

3. Select the desired timeslot and management data rate, in kbps. For sublinks, always select 8 kbps.
4. When done, press **<Enter>** to end.
   If the FRAME RL mode is selected the following line of the data form appears:

```
TS_NUM          SPEED
1               64
```

5. Select the desired timeslot. The management data rate is always 64 kbps. This selection is available for the main link only.
6. When done, press **<Enter>** to end.

DEF DP

Purpose

Define the communication parameters of the dial-out port and control the use of the call-out function. The communication parameters of the dial-out port can be different from the communication parameters of the supervisory port, which are selected by means of the DEF SP command.

Syntax

DEF DP

Use

1. To define the dial-out port communication parameters type:
   DEF DP<Enter>

   The dial-out port parameters data form is displayed. A typical form is shown below.

```
SPEED       DATA          PARITY          CALL_OUT_MODE
9600 bps    8             NO              NONE
```

2. Change the desired parameters and press **<Enter>** to end.

Table D-10 describes the dial-out port's parameters, function and range of values.

Table D-10. Dial-Out Port Communication Parameters

Parameter	Function	Values
SPEED	Selects the dial-out port data rate.	The available selections are 300, 1200, 2400, 4800 or 9600 bps. **Default: 9600**
DATA	Selects the number of data bits in the dial-out port word format	The available selections are 7 or 8 data bits **Default: 8**
PARITY	Controls the use of parity	**ODD** – Odd parity. **EVEN** – Even parity. **NO** – Parity disabled (only available with 8 data bits) **Default: NO**
CALL_OUT_MODE	Controls the use of the call-out function	**NONE** – the call-out function is disabled. **ALL** – FCD-E1 initiates a call after each new alarm. **MAJOR** – FCD-E1 initiates a call only when a new major alarm condition is detected. **Default: NONE**

DEF ML

Purpose

Select the main link parameters. Refer to *Table D-2* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF ML

Use

1. To define the main link parameters, type:
   DEF ML<Enter>

You will see the first line of the main link parameters data form. A typical data form is shown below:

```
FRAME     CRC-4     SYNC          IDLE_TS_CODE       RAI
G732N     NO        CCITT         3F                 DISABLE
```

2. Select the desired parameters, and then press **<Enter>** to end.

DEF MANAGER LIST

Purpose

Define or modify the network management stations to which the SNMP agent of this FCD system will send traps. You can define up to five managers. Each network management station is defined by entering its IP address and the corresponding subnet mask.

Syntax

DEF MANAGER LIST

Use

1. To define a management station, type:
   DEF MANAGER LIST<Enter>
2. You will see the first line of the managers list data form, which is used to define the IP address of the first management station. Type in the IP address of the desired management station. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).
3. After filling in the required address, press <**Enter**> to display the next line, and then type in the subnet mask in the dotted-quad format. The mask consists of four groups of digits in the range of 0 to 255, separated by periods. The net section must consist of 1s.

   A typical data form, as seen after both lines used to define the first management station have been filled in, is shown below:

```
IP ADDRESS    999.999.999.999
SUBNET MASK   999.999.999.999
```

4. Repeat the procedure described above to define the additional management stations (No. 2 through 5). After pressing <**Enter**> for the subnet mask of the fifth manager, you will see the current list in the following format:

```
CURRENT MANAGERS LIST PARAMETERS
MANAGER 1  IP ADDRESS IS: = 999.999.999.999
MANAGER 1 SUBNET MASK IS: = 999.999.999.999
MANAGER 2  IP ADDRESS IS: = 999.999.999.999
MANAGER 2 SUBNET MASK IS: = 999.999.999.999
MANAGER 3  IP ADDRESS IS: = 999.999.999.999
MANAGER 3 SUBNET MASK IS: = 999.999.999.999
MANAGER 4  IP ADDRESS IS: = 999.999.999.999
MANAGER 4 SUBNET MASK IS: = 999.999.999.999
MANAGER 5  IP ADDRESS IS: = 999.999.999.999
MANAGER 5 SUBNET MASK IS: = 999.999.999.999
```

DEF NAME

Purpose

Define the node name (up to eight alphanumeric characters).

Syntax

DEF NAME

Use

1. To define the FCD-E1 node name, type:
   DEF NAME<Enter>
   FCD-E1 displays the current name in the following format:

```
OLD NAME =              'old name'
```

   where **'old name'** is the name FCD-E1 is currently assigned.
   The current name is followed by the name entry form:

```
ENTER NODE NAME (MAX 8 CHARACTERS) =
```

2. Type the desired name, and then press **<Enter>**. The new name is displayed in the following format:

```
CURRENT NAME =          'name'
```

   where **'name'** is the FCD-E1 current node name.

DEF NODE

Purpose

Define the node number, or address, of FCD-E1. The allowed range is 0 to 255.

Syntax

DEF NODE

Use

1. To define the FCD-E1 node number, type:
   DEF NODE<Enter>

FCD-E1 displays the node entry form:

```
NODE (0 to 255) = 0
```

2. Type the desired number in the range of 0 to 255, and press **<Enter>** to end.

Note

Before entering a node number, make sure that section 2, PASSW, of the FCD-E1 internal switch S1 is not set to ON, because in such a case the default number (0) is enforced.

DEF ROUTE

Purpose

Define the network management stations to be statistically routed via the supervisory port. Up to five stations can be defined. The data is sent to the defined stations via the supervisory port regardless whether the station was predefined in the FCD-E1 network database or not.

Syntax

DEF ROUTE

Use

The use and the display format are similar to the DEF MANAGER LIST command.

The typical display is shown below:

```
ROUTE IP ADDRESS 1 IS: = 000.000.000.000
ROUTE IP ADDRESS 2 IS: = 000.000.000.000
ROUTE IP ADDRESS 3 IS: = 000.000.000.000
ROUTE IP ADDRESS 4 IS: = 000.000.000.000
ROUTE IP ADDRESS 5 IS: = 000.000.000.000
```

DEF PWD

Purpose

Define a new user password for FCD-E1.

Syntax

DEF PWD

Use

1. To define a new user password , type:

   DEF PWD

   The current password entry screen appears:

```
OLD PASSWORD = 'old password'
```

   where **'old password'** is the current password. The current password is followed by the password entry form:

```
NEW PASSWORD [4 TO 8 CHARS] =
```

2. Type the required password (4 to 8 characters). Carefully check that the specified password has been indeed typed in, and then press **<Enter>**. The new password is displayed in the following format:

```
CURRENT PASSWORD = 'password'
```

Note

Before entering a new password, make sure that the PASSW section of the FCD-E1 internal switch S1 is not set to ON, because in such case the default password (RAD) is enforced.

DEF SL

Purpose

Select the sublink parameters. Refer to *Table D-2* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF SL

Use

1. To define the sublink parameters, type:

   DEF SL<Enter>

   You will see the first line of the sublink parameters data form. A typical data form is shown below:

```
FRAME       CRC-4       SYNC        IDLE_TS_CODE          RAI
G732N       NO          CCITT       3F                    DISABLE
```

2. Select the desired parameters, and then press **<Enter>**. You will see the next line of the data form:

```
CGA             OOS_SIG             OOS_CODE
NONE            N/A                 00
```

3. Select the desired parameters, and then press **<Enter>** to display the next line:

```
MAP_MODE        START_TS        TS_TYPE         NUM_OF_TS
USER            N/A             N/A             N/A
```

4. Select the desired parameters, and then press **<Enter>**.
   - If in step 3 the MAP MODE has been set to SEQ, FCD-E1 displays the time and date fields, followed by the FCD-E1 prompt.
   - If the MAP MODE has been set to USER, after you press **<Enter>** you will see the first line of the sub timeslot map of the sublink. A typical display is shown below:

```
TS    : NO 01   NO 02   NO 03   NO 04   NO 05   NO 06   NO 07
      : NC      NC      NC      NC      NC      NC      NC
```

   Use the spacebar to move between timeslots. For each timeslot:
   - Select among VOICE, DATA (voice, respectively data timeslot allocated to the sublink), or NC (not connected) by pressing **<F>** or **<B>.**
   - After completing the first line, press **<Enter>** to continue to the next line. Repeat the procedure until all the timeslots are defined. The maximum number of timeslots is 31.

5. When done, press **<Enter>** to end.

DEF SP

Purpose

Define the supervisory port parameters. Refer to *Table D-3* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF SP

Use

1. To define the supervisory port parameters, type:

   DEF SP<Enter>

   The first line of the supervisory port parameters data form is displayed. A typical form is shown below.

```
SPEED    DATA  PARITY    INTERFACE      CTS       DCD_DEL      DSR
AUTO     8     NO        DCE            =RTS      0 MS         ON
```

2. Change the desired parameters and press **<Enter>** to display the next line:

```
POP_ALM   PWD                LOG_OFF              CALL_OUT_TRIGER
          ACTIVATE_CALL_OUT AUXILIARY_DEVICE
NO        NO                 NO                   NONE   ANY CASE
          TERMINAL
```

3. When done, press **<Enter>** to end.

Table D-11 describes additional parameters of the supervisory port available only through the supervisory terminal.

Table D-11. Additional Supervisory Port Parameters

Parameter	Function	Values
CTS	Controls the state of the CTS line in the CONTROL DCE port	**ON** – The CTS line is always ON (active) **=RTS** – The CTS line follows the RTS line. **Default: =RTS**
DCD_DEL	With the CONTROL DCE port defined as DTE, indicates the delay (in msec) between DCD=ON and sending of data	The available values are 0, 10, 50, 100, 200, and 300 msec. If you select a non-zero value when the port interface is programmed as DCE, you will receive ERROR 004 (illegal DCD_DEL and interface combination). **Default: 0**
DSR	Controls the state of the DSR line	**ON** – The DSR line is continuously on. It will switch to OFF for five seconds after the DTR line is switched OFF. If you select DSR=ON when INT=DTE, you will receive ERROR 005 (conflict in interface and DSR parameters) **=DTR** – The DSR line tracks the DTR line. **Default: ON**
POP_ALM	Controls the automatic sending of alarms to a terminal connected to the CONTROL DCE port	**YES** – The terminal automatically displays every 10 minutes the alarm status (or whenever an alarm which is not masked using the DEF ALM MASK command changes to ON). **NO** – The automatic display feature is disabled. **Default: NO**
PWD	Controls password protection	**YES** – Password protection enabled. **NO** – Password protection disabled. **Default: NO**
LOG_OFF	Controls the idle disconnect time of the CONTROL DCE port	**NO** – Automatic session disconnection disabled. To disconnect the session, use the BYE command. **3_MIN** – Automatic disconnection after three minutes if no input data is received by the CONTROL DCE port. **10_MIN** – Automatic disconnection after 10 minutes if no input data is received by the CONTROL DCE port. **Default: NO**

DEF SYS

Purpose

Define the system parameters. Refer to *Table D-1* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF SYS

Use

1. To define the FCD-E1 system parameters, type:

   DEF SYS<Enter>

   The system parameters data form is displayed. A typical form is shown below.

```
CLK_MASTER     CLK_FBACK      DATE_FORMAT
INT            NONE           YYYY-MM-DD
```

2. After the desired parameter values are selected, press **<Enter>** to end.

Table D-12 describes additional system parameter available only through the supervisory terminal.

Table D-12. Additional System Parameter

Parameter	Function	Values
DATE_FORMAT	Selects the date display format	The available selections are DD/MM/YYYY, and MM/DD/YYYY or YYYY-MM-DD. **Default: YYYY-MM-DD**

DEF TERM

Purpose

Define the control codes for use with one of the following types of terminals: TV920, VT52, VE100, Freedom 100/110 or Freedom 220, or reset the codes to 0.

If you are using a different type of terminal, use the F command to define the desired codes.

The codes used by the above-mentioned terminals are listed in *Table D-13*.

Table D-13. Supervision Terminal Control Codes

Function	Terminal Type				
	TV920	**VT52**	**VT100**	**Freedom 100/110**	**Freedom 220**
Clear Screen	1B2A0000	N/A	1B5B324A	1B2A0000	1B5B324A
Cursor Home	1E000000	1B480000	1B5B4800	1E000000	1B5B4800
Cursor Right	0C000000	1B424000	1B5B3143	0C000000	1B5B0143

Syntax

DEF TERM {'terminal type'}

Use

1. To reset the terminal control codes to 0, type:
   DEF TERM<Enter>
2. To select the control codes for one of the above-mentioned types, type:
   DEF TERM 'terminal type'<Enter>
   where '**terminal type**' stands for TV920, VT52, VT100, Freedom100 or Freedom220.
3. Press **<Enter>** again to end.

DSP AGENT

Purpose

Display the FCD-E1 agent parameters.

Syntax

DSP AGENT

Use

To display the agent parameters, type:

DSP AGENT

You will see the SNMP parameters data form. A typical form is shown below:

```
AGENT PARAMETERS
--------------------
IP  ADDRESS IS       : = XXX.XXX.XXX.XXX
MAC ADDRESS IS       : = XXX.XXX.XXX.XXX.XXX.XXX
```

Refer to the *DEF AGENT* on page D-15 for an explanation of the information displayed by this command.

DSP ALM

Purpose

Display the contents of the alarm buffer. This buffer can contain up to 100 alarms.

Syntax

DSP ALM [Option]

Use

1. To display the complete contents of the buffer, type:
   DSP ALM<Enter>

2. To display the complete buffer contents and then clear all the alarms, type:
   DSP ALM /CA<Enter>

The contents of the alarm buffer are displayed as a table with five columns. The columns include the alarm code, alarm description, the link on which the alarm condition has been detected, alarm status, date and time of occurrence.

A header precedes each block of alarms received from an FCD-E1. The header lists the node number and the assigned node name, and it serves as an easily identified separator between the alarms transmitted by different FCD-E1 units.

The alarm messages that can be displayed by the terminal are explained in *Chapter 5*.

DSP BERT CH/SL

Purpose

Display the results of an on-going bit error ratio measurement on the desired channel or sublink. When monitoring the BERT results, you may also start and stop error injection, and restart the error count by clearing the accumulated error results.

Note

Monitoring is not possible when using Telnet.

The error injection rate is defined by means of the DEF BERT command.

Syntax

DSP BERT CH {1 2} or DSP BERT SL

Use

1. To display the current results of a BER test on the data channel or sublink, type:
   DSP BERT CH 1<Enter> or DSP BERT CH 2<Enter>
   DSP BERT SL<Enter>

Note

These commands are valid only when the BER test (LOOP BERT) is active on the specified channel, otherwise you will see ERROR 055.
If you specify channel 2 for an FCD-E1/1/, you will see ERROR 054 (illegal parameter for current configuration).*

2. To display the current results of a BER test and then reset the error count, type:
   DSP BERT CH 1 /C<Enter> or DSP BERT CH 2 /C<Enter>
3. To monitor the results of a BERT test, type:
   DSP BERT CH 1 /R<Enter> or DSP BERT CH 2 /R<Enter>
   In this case, you will see the commands you can use while monitoring the BER test results, and then the BERT results themselves.

```
PRESS I FOR ERRORS INJECT
PRESS S FOR STOP ERRORS INJECT
PRESS C TO CLEAR ERROR BITS
```

Note

When using the single-error mode, pressing I injects a single error. To inject an additional error, first press S before pressing I.

To stop the monitoring and obtain again the command prompt, press **<CTRL-C>** (BREAK).

4. When using Telnet, it is not possible to monitor the results. Therefore, use the following command to display the results and start the injection of errors:

   DSP BERT CH 1 /I<Enter> or DSP BERT CH 2 /I<Enter>

   and the commands:

   DSP BERT CH 1 /S<Enter> or DSP BERT CH 2 /S<Enter>

   to display the results and then stop the injection of errors.

The BER test results displayed on the screen are correct for the instant the display command has been issued (or since the last time the counters have been cleared, whichever occurred last). When the /R option is used, the results are periodically updated. The results are presented in the following format:

```
ERROR_BITS       RUN_TIME(SEC) ERRORS(SEC)         SYNC_LOSS(SEC)
                 ERROR_INJECT
0                100           0                   0    OFF
```

The display fields are as follows:

ERROR_BITS	Total number of bit errors detected.
RUN_TIME(SEC)	Total time the test is running.
ERRORS(SEC)	Total number of seconds in which errors have been detected.
SYNC LOSS(SEC)	Total number of seconds in which loss of frame alignment occurred.
ERROR INJECT(SEC)	Indicates whether errors are injected (ON) or not (OFF).

Note

All the counters have a range of 0 through 65535. When the maximum value is reached, the counter freezes, therefore in general a value of 65535 indicates the counter has overflown.

DSP HDR TST

Purpose

Display the results of the last hardware test (made during power-on self-test and during regular operation).

Syntax

DSP HDR TST

Use

To display the hardware test report, type:

DSP HDR TST<Enter>

The display has one field that shows NO HARDWARE FAILURE if everything checks well or lists the detected problem: EPROM FAILURE, I/O EXP FAILURE, COUNTER FAILURE, ILLEGL SYS CNFG or SFIFO FAIL.

DSP PM

Purpose

Display the contents of the performance monitoring registers specified by AT&T Pub. 54016. This option is available only on E1 links with ESF framing. For an explanation of the performance monitoring registers, refer to the ***Error! Cannot open file.*** section in *Chapter 5*.

Syntax

DSP PM {ML SL} [/C] [/CA]

Use

1. To display the main link performance monitoring registers, type:
   DSP PM ML<Enter>
2. To display the sublink performance monitoring registers, type:
   DSP PM SL<Enter>

Note

If you specify the sublink for a version without sublink, you will see ERROR 054 (illegal parameter for current configuration).

3. To display the performance monitoring registers and then clear only the event register, type:
   DSP PM ML /C<Enter> or DSP PM SL /C<Enter>
4. To display the performance monitoring registers, clear all the performance monitoring registers of the selected link and restart the count intervals, type:
   DSP PM ML /CA<Enter> or DSP PM SL /CA<Enter>

The performance monitoring registers are listed in the following order (the numbers in brackets indicate the range of values for each register):

```
ESF ERROR EVENTS     =            [0] ..... [1000]
CURRENT ES           =            [0] ..... [900]
CURRENT UAS          =            [0] ..... [900]
CURRENT SES          =            [0] ..... [900]
CURRENT BES          =            [0] ..... [900]
CURRENT LOFC         =            [0] ..... [255]
CURRENT CSS          =            [0] ..... [255]
CURRENT TIMER        =            [0] ..... [900]
INTERVAL mm ES=nnn UAS=nnn BES=nnn SES=nnn LOFC=nnn CS=nnn
24 HOUR ES           =            [0] ..... [65535]
24 HOUR UAS          =            [0] ..... [65535]
24 HOUR SES          =            [0] ..... [65535]
24 HOUR BES          =            [0] ..... [65535]
24 HOUR LOFC         =            [0] ..... [255]
24 HOUR CSS          =            [0] ..... [255]
LAST 24 DEGRADE MIN  =            [0] ..... [1440]
24 HOUR INTERVAL     =            [0] ..... [96]
```

where: **mm** is 0 to 96 and **nnn** is 0 to 900.

DSP REM AGENT

Purpose

Display information on the SNMP agents that are known to the IP router of the FCD-E1 when SNMP management is enabled.

Syntax

DSP REM AGENT

Use

1. To display the remote agent information, type:

   DSP REM AGENT<Enter>

   If no agent is known, you will see a CANNOT FIND ANY REMOTE AGENT message. Otherwise, you will see a table listing the remote agents. A typical table is shown below:

```
IP ADDRESS       MUX NAME         DISTANCE
-----------------------------------------

192.114.50.2     FCD2             006
```

The fields displayed for each agent are as follows:

IP ADDRESS The IP address of the remote agent.

MUX NAME The logical name of the remote agent.

DISTANCE The distance is a metric that indicates the logical distance (through the management network) to the remote agent, and is used, among other factors, in the selection of the optimal route to be used by the management traffic.

The distance is assigned as follows:

- Each segment between two IP routers is assigned a weight of 6. For example, when the path to an agent passes two FCD-E1 units with their SNMP management enabled, the distance is 12.
- When the management network includes one or more additional distinct (alternate) paths between two IP routers that connect to the same remote agent, each such path is assigned a weight of 7 (6 + 1), 8 (6 + 2), etc. per segment. For example, if the route in the example given above has an additional path in parallel with one segment, the additional route has a distance of 13; when additional paths are found in parallel with each segment, the distances will be 13, 14, 15.

DSP ST CH

Purpose

Display status information the data channel.

Syntax

DSP ST CH {1 2}

Use

To display the data channel status information, type:

DSP ST CH 1<Enter> or DSP ST CH 2<Enter>

A typical channel status display is shown below:

```
STATUS OF CHANNEL - 1
LOOPS TYPE   = LOCAL    REMOTE    BERT    T_INBAND    R_INBAND
               NO       NO        NO      NO          NO
PORT STATE   = NOT CONNECTED
RTS STATE    = OFF
INTERFACE    = V.35
```

The fields included in the status information display are listed below:

LOOPS TYPE Displays the current state of the loops and tests on the data channel.

The LOCAL field indicates the state of the local loopback:

NO local loopback is deactivated.

YES local loopback is activated.

The REMOTE field indicates the state of the remote loopback:

NO remote loopback is deactivated.

YES remote loopback is activated.

The BERT field indicates the state of the BER test:

NO BER test is deactivated.

YES BER test is activated.

T_INBAND This field displays **NO** to indicate that the user requested the sending of the inband remote loopback activation sequence.

R_INBAND This field displays **NO** when a loopback has been connected as a result of the reception of the inband remote loopback activation sequence.

PORT STATE Displays whether the dat channel is connected to the main link:

CONNECTED the channel is connected.

NOT CONNECTED the channel is not connected.

RTS Displays the state of the RTS line in the channel connector:

OFF the RTS line is not active.

ON the RTS line is active.

INTERFACE Displays the interface type:

- **V.35** – V.35 interface
- **X.21** – X.21 interface
- **RS-530** – RS-530 interface or V.36/RS-449 via an adaptor cable
- **ETHERNET**– Ethernet 10BaseT bridge
- **ETHERNET Q** – Ethernet 10BaseT bridge with VLAN support

DSP ST ML

Purpose

Display main link status information.

Syntax

DSP ST ML [/R] [/C]

Use

1. To display the main link status information, type:
   DSP ST ML<Enter>
2. To monitor the main link status, type:
   DSP ST ML /R<Enter>
   To stop the monitoring, press BREAK.
3. To display the main link status information, and then clear its error event registers, type:
   DSP ST ML /C<Enter>

A typical main link status display is shown below.

```
STATUS OF  -  MAIN LINK
TYPE       =  E1
FUNCTION   =  COPPER DSU
ALARMS        L.SYNC LOSS      R.SYNC_LOSS
              ===========      ===========
              ON               OFF
LOOPS             DIGITAL             ANALOG
              LOCAL     REMOTE    LOCAL     REMOTE
              ======    =======   ======    =======
              NO        NO        NO        NO
DOWNLOAD MODE  =  NONE
OOS CNTR   =  1
BPV LAST MINUTE =  0
BPV WORST MINUTE =  0
```

The fields included in the status information displays are listed below:

TYPE Indicates the main link interface, E1.

FUNCTION Indicates the main link interface type, COPPER LTU or COPPER DSU.

ALARMS Indicates the state of the port alarms:

L.SYNC LOSS - state of local frame synchronization.

R.SYNC LOSS - state of remote frame synchronization.

LOOPS Indicates the state of the loops that can be activated on the data port:

- User-activated: local and remote loopbacks.
- Analog or digital.

DOWNLOAD MODE Displays the inband management mode selected for the main link: **TS0/F, DEDIC TS** or **DEDIC FR**

OOS CNTR Displays the number of local loss of frame alignment events detected since the last time the counters were cleared.

BPV LAST MINUTE Displays the number of BPV events detected in the last minute.

BPV WORST Displays the number of BPV events detected during the worst minute since the last time the counters were cleared.

Note *BPV counts are available only with the CRC-4 function disabled.*

DSP ST SL

Purpose

Display the sublink status information. This information is available only for the FCD-E1 with a sublink; otherwise, you will see ERROR 054 (illegal parameter for current configuration).

Syntax

DSP ST SL [/R] [/C]

Use

The use and the display format are similar to the DSP ST ML command.

DSP ST SYS

Purpose

Display system status information.

Syntax

DSP ST SYS

Use

To view the system status, type:

DSP ST SYS<Enter>

A typical system status display is shown below.

```
NODE              = 'node number'
NAME              = 'FCD-E1 name'
NODAL CLOCK       = INT
SOFTWARE VER      = X.Y
HARDWARE VER      = Z.V
FCD TYPE          = E1/X/S1
POWER SUPPLY      = 220V
```

The fields included in the system status information displays are listed below:

NODE	The node number (0 through 255) assigned to the FCD-E1.
NAME	The system name assigned to the FCD-E1.
NODAL CLOCK	Indicates the nodal clock source: **INT**, **CH1**, **CH2**, **ML** or **SL**.
SOFTWARE VER	The software version of the FCD-E1.
HARDWARE VER	The hardware version of the FCD-E1.
FCD TYPE	According to equipment type: X denotes the number of data channels (1 or 2), S1 denotes the sublink (if exists).
POWER SUPPLY	Indicates the power supply type installed in the FCD-E1.

DSP TS

Purpose

Display information on the use and type of main link timeslots.

Syntax

DSP TS

Use

1. To display the timeslot information, type:

   DSP TS<Enter>

   A typical display is shown below:

```
TS   :  NO 1   NO 2   NO 3   NO 4   NO 5   NO 6   NO 7   NO 8   NO 9
NO 10
TYPE:  NC      NC      NC      NC      NC      NC      NC      NC      NC
NC
DEST:  NA      NA      NA      NA      NA      NA      NA      NA      NA
NA
TS   :  NO 11  NO 12  NO 13  NO 14  NO 15  NO 16  NO 17  NO 18  NO 19
NO 20
TYPE:  NC      NC      NC      NC      NC      NC      NC      NC      NC
NC
DEST:  NA      NA      NA      NA      NA      NA      NA      NA      NA
NA
TS   :  NO 21  NO 22  NO 23  NO 24  NO 25  NO 26  NO 27  NO 28  NO 29
NO 30  NO 31
TYPE:  NC      NC      NC      NC      NC      NC      NC      NC      NC
NC     NC
DEST:  NA      NA      NA      NA      NA      NA      NA      NA      NA
NA     NA
```

The fields included in the timeslot displays are listed below:

TS Indicates the main link timeslot number, 1 through 31.

TYPE Indicates the timeslot type:

- **NC** timeslot not connected (FCD-E1 inserts the idle code in such timeslots).
- **DATA** data channel.
- **VOICE** voice channel.
- **DEDIC** timeslot dedicated to management traffic.

DEST Indicates the port (sub or channel) using that timeslot.

EXIT

Purpose

End the current session and return control to the FCD-E1 front panel.

Syntax

EXIT

Use

To end the current communication session, type:

EXIT<Enter>

F

Purpose

Define the codes used to send to the supervision terminal to perform the following terminal control functions:

- Clear screen.
- Move cursor to screen home position.
- Move cursor to the right by one position.

If you have a TV920, VT52, VT100, Freedom 100/110 or Freedom 220 terminal, you can use the DEF TERM command to set the control codes for that terminal.

Syntax

F

Use

1. To display the current codes, type:
   F<Enter>

   The terminal function entry screen is displayed. The screen includes three separate lines, displayed one after the other. A typical screen, showing all the three lines, is shown below:

```
CLEAR SCREEN =hhhhhhhh
CURSOR HOME  =hhhhhhhh
CURSOR RIGHT =hhhhhhhh
```

   where **h** indicates hexadecimal digits.

2. To change a code, enter the appropriate hexadecimal digit under the first digit of the code, the cursor advances to the next digit.
3. Repeat the procedure until all the necessary digits are changed, and then press **<Enter>** to end.

HELP

Purpose

Display an index of the supervision terminal commands used in the explicit mode, and the options available for each command.

Syntax

HELP or H

Use

To display the index of commands, type:

HELP<Enter>

You will see the first HELP page. Press the spacebar to see the next page.

INIT DB

Purpose

Load the default parameter values (see *Table D-14*) instead of the user configuration.

Syntax

INIT DB

Use

To load the default parameters, type:

INIT DB<Enter>

FCD-E1 displays the following message:

```
FCD Supervisory Port On Line. Type 'H' for help
```

Then the time and date fields followed by the FCD-E1 prompt.

Table D-14. FCD-E1 Default Configuration Used with Supervision Terminal

Type	Parameter Designation	Default Value
General	PASSWORD	RAD
	NODE (node number)	0
	CLEAR SCREEN	00 00 00 00
	CURSOR HOME	00 00 00 00
	CURSOR RIGHT	00 00 00 00
System	CLK_MASTER	INT
	CLK_FBACK	NONE
	DATE_FORMAT	YYYY-MM-DD
Main Link and Sublink	FRAME	G732N
	CRC-4	NO
	SYNC	CCITT
	IDLE_TS_CODE	3F
	RAI	DISABLE
	CGA	NONE
	OOS_SIG	N/A
	OOS_CODE	00
	MAP_MODE	USER
	START_TS	N/A
	TS_TYPE	N/A
	NUM_OF_TS	N/A
	Timeslot Map Type (USER mode only)	NC

Table D-14. FCD-E1 Default Configuration Used with Supervision Terminal (Cont.)

Type	Parameter Designation	Default Value
Data Channels	MULTIPLIER	64
	SPEED	NC
	FIFO SIZE	AUTO
	CLK_MODE	DCE
	CTS	ON
	MAP_MODE	USER
	START_TS	N/A
	TS_TYPE	N/A
	Timeslot Map Type (USER mode only)	NC
	ETHERNET MODE	HALF
	BRIDGING	FILTER
SP (Supervisory Port)	SPEED	AUTO
	DATA	8
	PARITY	NO
	INTERFACE	DCE
	CTS	=RTS
	DCD_DEL	0_MS
	DSR	ON
	POP_ALM	NO
	PWD	NO
	LOG_OFF	NO
	AUXILIARY_DEVICE	TERMINAL
DP (Dial-out Port)	SPEED	9600 bps
	DATA	8
	PARITY	NO
	CALL_OUT_MODE	NONE
Download	DNLOAD MODE	NONE
BERT	PATTERN	2E3-1
	ERROR_INJECTION_RATE	NO ERR
	RX_INBAND	DISABLE

LOOP

Purpose

Activate the specified user-initiated test or loopback.

Note

A remote loopback cannot be activated when a local loopback is already connected, and vice versa. In such case, you will see ERROR 051 (illegal port loop configuration).

Syntax

LOOP {'loopback'}

Use

1. To activate a main link loopback, type:

```
LOOP LOCAL ANALOG ML<Enter>      or    LP LOC ANA ML<Enter>
LOOP REMOTE ANALOG ML<Enter>     or    LP REM ANA ML<Enter>
LOOP LOCAL DIGITAL ML<Enter>     or    LP LOC DIG ML<Enter>
LOOP REMOTE DIGITAL ML<Enter>    or    LP REM DIG ML<Enter>
```

2. To activate a sublink loopback, type:

```
LOOP LOCAL ANALOG SL<Enter>      or    LP LOC ANA SL<Enter>
LOOP REMOTE ANALOG SL<Enter>     or    LP REM ANA SL<Enter>
LOOP LOCAL DIGITAL SL<Enter>     or    LP LOC DIG SL<Enter>
LOOP REMOTE DIGITAL SL<Enter>    or    LP REM DIG SL <Enter>
LOOP BERT SL
LOOP INBAND SL
```

3. To activate a channel loopback or test, type:

```
LOOP LOCAL CH X<Enter>           or    LP LOC CH X<Enter>
LOOP REMOTE CH X<Enter>          or    LP REM CH X<Enter>
LOOP BERT CH X<Enter>            or    LP BERT CH X<Enter>
LOOP INBAND CH X<Enter>          or    LP INBAND CH X<CR
```

where **X** is the channel number.

Note

The activation of an inband loopback is made by repeatedly transmitting the activation sequence therefore, the loopback can be considered as activated only after approximately 2 seconds.

If the requested loopback is already active, you will receive ERROR 053 (current loop already being performed).

If the requested loopback is not supported by the FCD-E1 version, you will receive ERROR 054 (illegal parameter for current configuration).

If you are trying to activate a loopback on channel 2 of an FCD-E1 with an Ethernet port, you will see ERROR 055 (illegal command for port mode). Nevertheless BERT (LOOP BERT) is allowed.

MM

Purpose

Display the main menu for orientation in using the mnemonic commands.

Syntax

MM

Use

To display the main menu, type:

```
MM<Enter>
```

PASSWORD

Purpose

Enter the password when prompted to type the password upon the start of a control session.

Syntax

PWD=<SP>'password'

Use

When you see the prompt PASSWORD>, type:

PASSWORD= <SP>'password'<Enter>

where 'password' is the string of four to eight alphanumeric characters that has been defined by the user (or the default, RAD, as appropriate).

If you entered the correct password, you will see the FCD-E1 working prompt, **FCD>**.

RESET

Purpose

Reset the FCD-E1 system.

Syntax

RESET

Use

To reset the FCD-E1, type:

RESET<Enter>

You are requested to confirm the operation.

TIME

Purpose

Set the time for the FCD-E1 internal clock.

Syntax

TIME

Use

1. To set the FCD-E1 internal clock time, type:

   TIME<Enter>

   You will see the first line of the FCD-E1 time entry form:

```
HOUR   = 14
```

2. Use **<F>** or **<B>** to change the hour and press **<Enter>** to see the next line.

```
MINUTE    = 02
```

3. Use **<F>** or **<B>** to change the minutes and press **<Enter>** to see the next line.

```
SECOND    = 05
```

4. Use **<F>** or **<B>** to change the seconds and press **<Enter>** at the correct instant to end.

   FCD-E1 displays the time and date fields (note that time has changed), followed by the FCD-E1 prompt.

Appendix E
IR-ETH Interface Module

E.1 Introduction

IR-ETH is an interface module for RAD devices, used for converting the Ethernet (10BaseT) electrical levels to the host device TTL levels. It also converts the Ethernet protocol to HDLC to enable long-distance transmission and avoid the Ethernet collision limitation.

IR-ETH includes an internal, self-learning Ethernet bridge, which enables a high performance link between two Ethernet segments at a low transmission rate. The low-speed HDLC transmission is sent over the link and then converted back to an Ethernet signal at the remote unit.

IR-ETH has a 10BaseT interface complying with the IEEE 802.3 standard, terminated in an RJ-45 shielded connector, which can operate over UTP and STP media. The Ethernet port with 10BaseT operates in full-duplex mode.

The optional built-in Ethernet Bridge is a high performance remote, self-learning bridge. It is ideal as a LAN extender or segmenter over E1 link applications. The bridge operates as a media access (MAC) layer remote bridge with self-learning capabilities. It learns and automatically recognizes the addresses of the nodes attached to the local LAN (the LAN directly attached to the FCD-E1 interface), and uses this information to filter the LAN traffic. The address information is stored in tables, which can store up to 10,000 addresses. The address information is automatically updated (aging time is 5 minutes, that is, if no frames are received from a node for 5 minutes, the node address is automatically removed from the tables to ensure that only fresh addresses are used).

Therefore, the bridge blocks the packets addressed to local nodes, and forwards through the FCD-E1 link only multicasts, broadcasts, and packets addressed to nodes attached to the remote LAN.

Filtering and forwarding can be performed at a rate of up to 15,000 packets per second (provided the bandwidth selected on the E1 link is sufficient to carry the resulting payload rate). When bridging is not necessary, e.g., for LAN extender applications, the user can disable the bridge. In this case, the FCD-E1 operates as a repeater that transfers transparently all the traffic to the remote end.

The Ethernet channel interface connects to the TDM bus through a bus interface similar to that of the data channel. The throughput available to the external equipment is determined by the data rate configured by the user.

The remote bridge operates at the physical and data link layers of the OSI model, and is therefore completely transparent to higher-level protocols, such as TCP/IP,

DECnet, XNS, ISO, and to operating systems, such as NetWare, VINES, and 3COM+.

Figure E-1 shows a typical application using an Ethernet interface bridge. Each FCD-E1 unit is connected to an Ethernet network via the Ethernet Interface bridge.

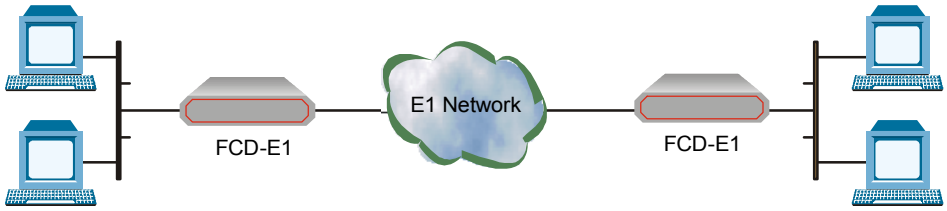


Figure E-1. Typical Application of FCD-E1 with IR-ETH Module

E.2 IR-ETH Interface Option

Figure E-2 shows the rear panel of FCD-E1 with the IR-ETH interface option.

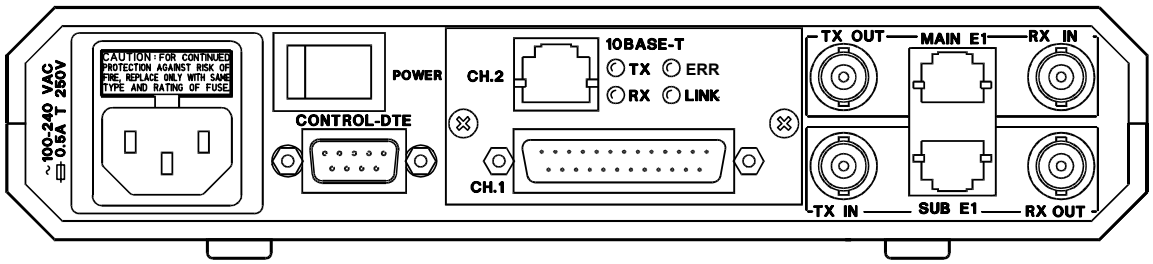


Figure E-2. IR-ETH Ethernet Bridge, 10BaseT Rear Panel

To connect the external equipment to the Ethernet interface, use standard Ethernet cables with RJ-45 connectors.

E.3 Technical Specifications

General	*LAN Table*	10,000 addresses
	Filtering and Forwarding	15,000 pps
	Buffer	256 frames
	Delay	1 frame
	Traffic Handling	Remote MAC-layer bridge with self-learning
LAN	*Standard*	Conforms to IEEE 802.3/Ethernet
	Data Rate	10 Mbps (20 Mbps 10BaseT FDX)
	Connector	10BaseT (UTP): Shielded RJ-45
WAN	*Protocol (internal)*	HDLC
	Data Rate	According to the FCD-E1 transmission rate

E.4 Installation and Operation

Although the IR-ETH interface board contains an internal DIP switch on board, this switch is not in use because the corresponding functions are software-controlled.

LAN Installation

Ethernet with UTP (10BaseT) connectors is designated as a Station. To install 10BaseT, either a straight cable or a cross-cable may be required. Use a cross-cable when connecting to a port that does not implement the crossover function internally. Otherwise, use a straight cable. (Hubs usually do implement the crossover function internally while network interface cards and other devices do not).

Table E-1 lists pinout of the IR-ETH RJ-45 connector.

Table E-1. RJ-45 Pinout

Pin	Name	Function
1	TD (+)	Transmit data positive
2	TD (–)	Transmit data negative
3	RD (+)	Receive data positive
6	RD (–)	Receive data negative

LED Indicators

Figure E-2 shows the indicators located on the rear panel of an FCD-E1 unit with the Ethernet bridge option for the UTP connectors. *Table E-2* lists the IR-ETH LED indicators and describes their functions.

Table E-2. IR-ETH Bridge LED Indicators

LED Name	Function	Color
LINK	Lights when the Ethernet interface is connected to an active LAN (i.e., a LAN with at least one active station)	Green
ERR	During regular operation, lights when a buffer overflow occurs	Yellow
TX	Lights when transmit activity is present on the Ethernet interface	Yellow
RX	Lights when receive activity is present on the Ethernet interface	Yellow

Appendix F
IR-ETH/Q Interface Module

F.1 Introduction

IR-ETH/Q is an interface module for RAD devices, used for converting the Ethernet (10BaseT) electrical levels to the RAD unit TTL levels. It also converts the Ethernet protocol to HDLC to enable long distance transmission and avoid the Ethernet collision limitation. The IR-ETH/Q module also supports IEEE 802.1/Q frames (VLAN tagged frames).

IR-ETH/Q includes an internal, self-learning Ethernet bridge, which enables a high performance link between two Ethernet segments at a low transmission rate. The module also supports VLAN applications. The low-speed HDLC transmission is sent over the link and converted back to an Ethernet signal at the remote unit.

Figure F-1 shows a typical application using an Ethernet interface bridge. Each unit is connected to an Ethernet network via the Ethernet interface bridge.

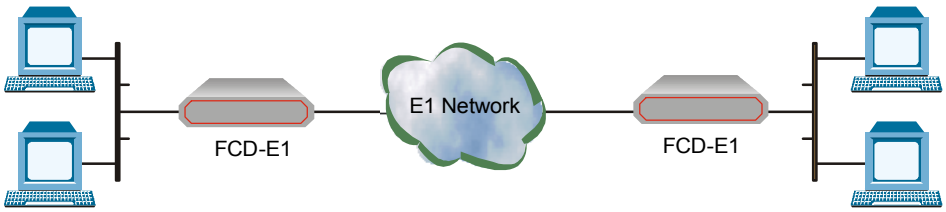


Figure F-1. Typical Application of FCD-E1 with IR-ETH/Q Module

F.2 IR-ETH/Q Interface Options

Figure F-2 shows the rear panel of FCD-E1 with the IR-ETH/Q interface options. *Table F-1* lists the module's RJ-45 connector pinout.

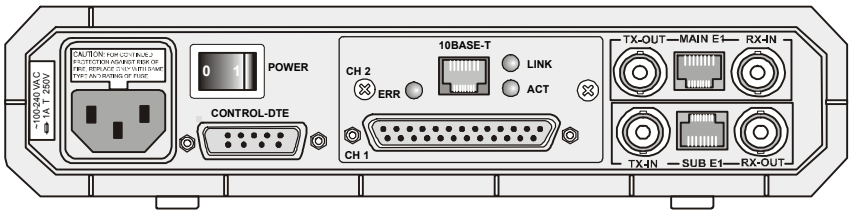


Figure F-2. IR-ETH/Q Ethernet Bridge, 10BaseT Rear Panel

Table F-1. RJ-45 Connector Pinout

Pin	Name	Function
1	TD (+)	Transmit data positive
2	TD (-)	Transmit data negative
3	RD (+)	Receive data positive
6	RD (-)	Receive data negative

F.3 Technical Specifications

General	*LAN Table*	2,000 addresses
	Buffer	200 kbytes
	Traffic Handling	Remote MAC-layer bridge with self-learning
LAN	*Standard*	Conforms to IEEE 802.3/Ethernet and supports IEEE 802.1/Q frames
	Data Rate	10 Mbps (20 Mbps 10BaseT FDX)
	Connectors	10BaseT (UTP): Shielded RJ-45
WAN	*Protocol*	HDLC
	Data Rate	According to the FCD-E1 transmission rate

F.4 Installation and Operation

Although the IR-ETH interface board contains an internal DIP switch on board, this switch is not in use because the corresponding functions are software-controlled.

Note IR-ETH/Q does not support auto negotiation. Therefore, the equipment connected to IR-ETH/Q should **not** be set to auto negotiation mode and the half/full duplex setting should be made manually (by means of the DEF CH 2 command).

LED Indicators

Figure F-2 shows the indicators located on the rear panel of an FCD-E1 unit with 10BaseT Ethernet/Q option. *Table F-2* explains the functions of the Ethernet/Q interface indicators.

Table F-2. IR-ETH/Q Bridge LED Indicators

LED Name	Function	Color
LINK	Lights when the Ethernet interface is connected to an active LAN (i.e., a LAN with at least one active station)	Green
ACT	Flashes when transmit and/or receive activity is present on the Ethernet interface	Yellow
ERR	During regular operation, lights when a buffer overflow occurs.	Red

Connecting to LAN

Use either a straight cable or a cross-cable for the LAN connection.
Use a cross-cable when connecting to a port that does not implement the crossover function internally. Otherwise, use a straight cable.

Note *Hubs usually implement the crossover function internally, while network interface cards and other devices do not.*

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RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

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Manual Name: FCD-E1

Publication Number: 172-200-01/06

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Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

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